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Performance of Three Diverter-Type Mechanical Grain Samplers and the Pelican

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CONTENTS

Page

Background of the research 3
Procedure. 3
  Grain handling facilities 3
  Grain samplers 3
  Responsibility for sampler operation and sample collection 5
  Sampling sequence and interval. 5
  Statistical pattern followed. 5
  Lot composition, preparation, and handling 5
  Lot separation into components. 8
  Operating temperatures. 8
  Sample analysis 8
Results and discussion 8
  Lot characteristics. 8
  Sampler performance 12
  Laboratory analysis error 23
  Secondary sampling 23
Summary 26
Tables 27

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Performance of Three Diverter-Type Mechanical Grain Samplers and the Pelican

(A progress report)

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BACKGROUND OF THE RESEARCH

The economic advantages of using 100-ton-capacity covered hopper cars for grain transport has stimulated interest in use of mechanical grain samplers to replace manual sampling with 5-foot probes. Hopper cars containing grain 12 to 14 feet deep create a challenging situation for manually inserted sampling devices.

Mechanical samplers permit drawing a sample from the grain stream at time of loading or unloading. The mechanically drawn samples, if representative of the grain being sampled, benefit the entire grain industry. Benefits include faster turnaround of railroad cars, efficiency of larger hopper cars, and elimination of trimming in boxcars. The objective of this research was to measure the accuracy and variability of three commercially available mechanical grain samplers and a standard pelican sampler. The probe was not included in this research because the grain was cycled between bins and probing of the deep bins would have been impractical.

PROCEDURE

Grain Handling Facilities

Facilities for conducting the research were provided by a commercial grain company (Cargill, Inc.) and consisted of grain bins, conveying equipment and spouts, scales, and sieves for making up test lots and later separating the lots into their individual components. The layout of these facilities is shown in figure 1. The weigh buggy used for weighing the lots of grain had a 10,000-lb. capacity and was mounted on load cells. Scale accuracy was within 0.1 percent of full scale. Accuracy was determined using official test weights borrowed from the State of Minnesota.

Grain Samplers

Three diverter-type mechanical samplers were supplied by the Gamet Manufacturing Company, the Gustafson Manufacturing Company, and the Strand Manufacturing Company. They were models available in June 1965 and were not necessarily of the same construction as currently available models. The diverter slot width of each was set at 0.75 inch ± 0.031 was adjusted to travel across the grain stream at 100 ft./min. ± 5 percent. Sampling interval was adjustable to 30 seconds ± 10 percent and to 60 seconds ± 10 percent. Standard 10-inch-diameter mounting flanges,

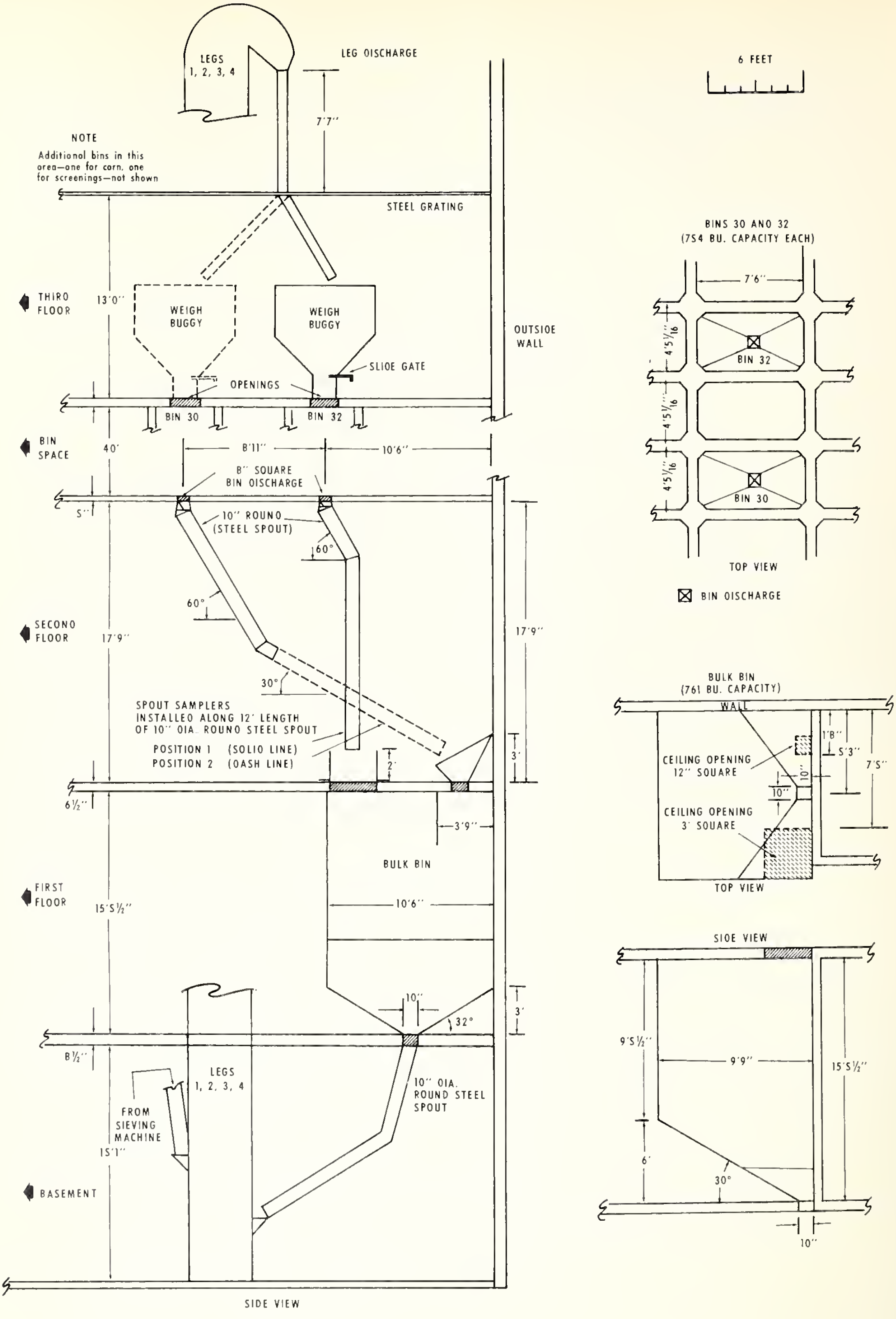

Figure 1.--Bins and related equipment used for grain sampling research.

spaced 48 inches apart, were provided at inlet and outlet ends of each sampler to simplify installation of the samplers in upper, middle, and lower positions along the spout (fig. 2). See figure 3 for sketch of a typical diverter-type sampler.

An official pelican sampler was supplied by the Grain Division, Consumer and Marketing Service (C&MS), U.S. Department of Agriculture.

Responsibility for Sampler Operation and Sample Collection

Effort was made to achieve optimum, yet typical, operating conditions without bias to any one device. Each manufacturer was furnished a copy of the test procedures, and each supplied a representative who operated his device. Testing did not start until each representative indicated his device was ready. Electric timers reading to one one-hundredth of a second were used to check the average diverter velocity across the grain stream in either direction. During each sampling run the manufacturer's representative collected each increment sample[1] in a separate plastic bag. The pelican samples were drawn by an experienced member of the Grain Division, C&MS.

Sampling Sequence and Interval

Sampling sequence and interval between samplers were controlled by electrical timing devices adjusted so the upper sampler would sample first, the middle sampler second, and the lower sampler third. The manually operated pelican sampler was always last, at the bottom and near the entrance to the lower bin.

A 30-second sampling frequency was used with a 4,000 lb./min. flow rate and a 60-second frequency was used with a 2,000 lb./min. flow rate. These frequencies provided one increment sample for each sampler from each 2,000 lb. of wheat flowing through the samplers. For a 30-second sampling frequency the middle, bottom, and pelican samplers were actuated 7 1/2, 15, and 22 1/2 seconds, respectively, after the upper sampler; 30 seconds after the upper sampler was actuated the first time, it was reactivated, and so forth. For the 60-second sampling frequency these intervals were doubled.

Statistical Pattern Followed

The tests included two flow rates, two spout angles, and three mechanical sampler spout positions. The sequence of events which were followed in handling the 12 lots is shown in table 1. Each of the 12 lots was handled through at least four cycles of sampling and reelevation, which gave a range of homogeneity from very poor to the best that can be expected in routine grain handling as indicated by preliminary investigations. Although the statistical plan for this research required only four cycles of handling and sampling per lot, an additional cycle was added to lots 1, 5, 6, and 8 through 12 to obtain information on increment sample size at flow rates greater and less than 2,000 and 4,000 lb. per minute. Since a mechanical problem developed during the fifth cycle of lot 1 and no data were obtained, a sixth cycle was performed.

Lot Composition, Preparation, and Handling

Twelve test lots (40,000 lb. each) consisting of 4.97 percent whole kernel corn, 90.10 percent whole kernel wheat, and 4.93 percent wheat-free screenings were used. These component levels were selected to simulate unusually difficult sampling conditions (grain in trade channels normally contains considerably less than 10 percent of other components). The whole kernel corn and wheat were obtained by screening lots of suitable quality and moisture content. The

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[1] An increment sample is defined as the sample drawn during one traverse of a diverter (or pelican) through the grain stream.

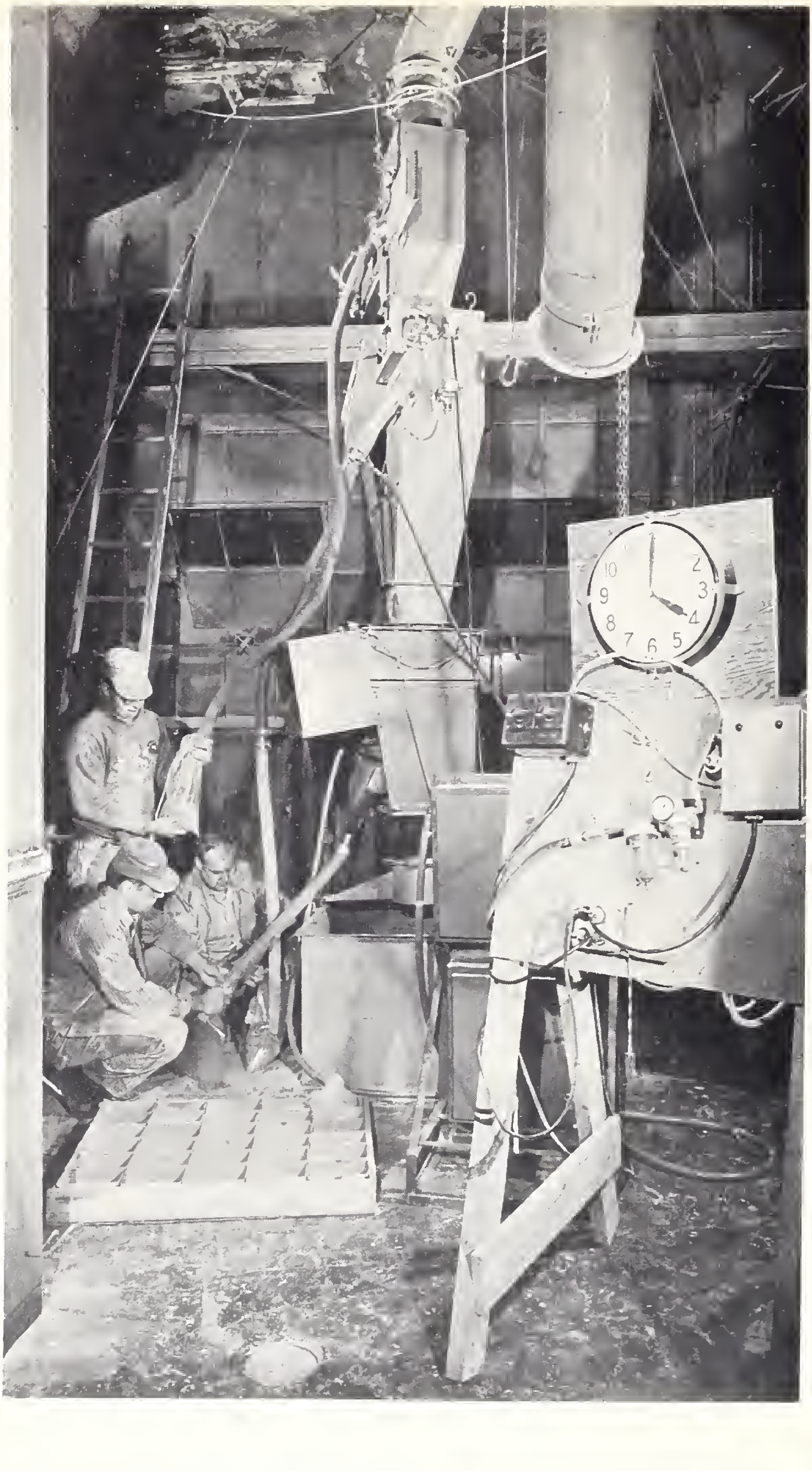

Figure 2.--Three mechanical samplers in series each drew samples of wheat flowing vertically from an upper to a lower bin. When operated at a 30 degree angle the samplers were connected to the sloping spout shown above the clock. Electric timers controlled frequency and sequence of sampling. A pelican sampler (not shown) was used at lower end of spout.

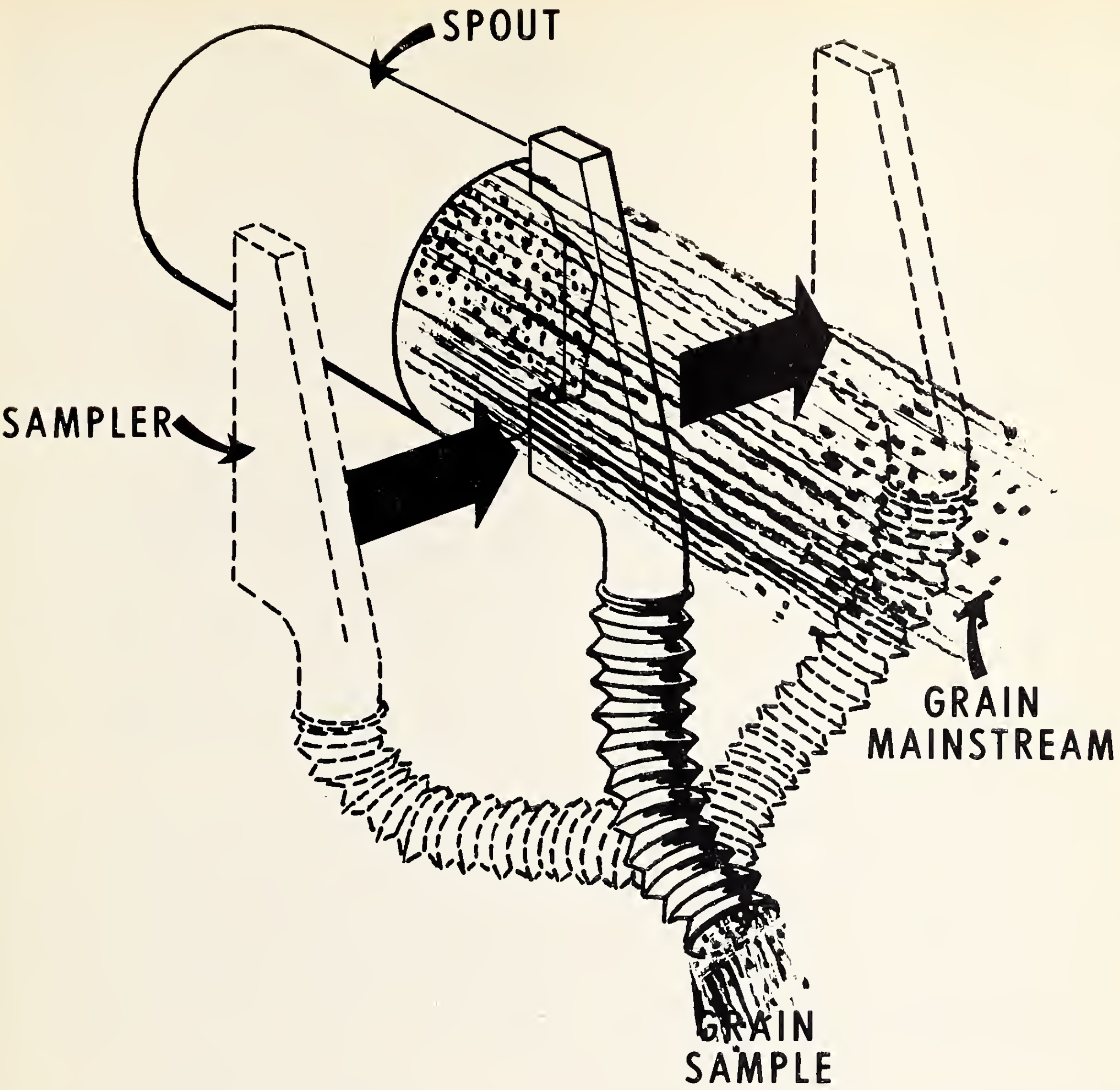

Figure 3.--Operating principle of diverter-type sampler.

screenings obtained from grain other than wheat had the following analyses:

Component	Percent
Foxtail (Setaria spp.)	52
Inert material	24
Lambsquarters (Chenopodium album L.)	12
Pigweed (Amaranthus spp.)	5
Wild mustard (Brassics kaber (DC.) Wheeler)	3
Ladysthumb (Polygonum persicaria L.)	2
Other seeds[2]	2
	100

For cycle one, each lot was layered in the upper bin with 36,000 lb. of wheat on the bottom, 2,000 lb. of screenings in the middle, and 2,000 lb. of corn on the top. During each cycle, the layered grain was mixed while flowing out of upper bin, flowing into and out of lower bin, flowing into and out of weigh buggy, and flowing into upper bin. Thus, the grain was mixed six times during each cycle.

At the beginning of each cycle the upper bin discharge gate was opened 5 seconds before the upper sampler was activated. This insured a full flow of grain before the first sample was drawn by each sampler. The calibrated slide gate at the upper bin outlet controlled the flow rate.

A stop watch was used to measure the time (to the nearest second) required for the grain in each lot of each cycle to flow through the sampling spout. Timing started the instant grain appeared at the end of the spout (where pelican samples were drawn) and stopped when the grain flow ended. The beginning and ending of grain flow was distinct.

Lot Separation Into Components

After completion of cycling and sampling, each lot was separated into components by the sieving device. Weights of the recovered components for each of the 12 lots are shown in table 2.

Each lot was adjusted to 40,000 lb. before recycling by adding the appropriate amount of each component. By definition, lot 1 became lot 2, 3, etc. after being separated into its components and after again being layered in the upper bin. It was reasoned that differences in physical characteristics of the corn, wheat, and screenings caused by handling and sieving would be less than differences between new quantities of the same components.

Operating Temperatures

A wide range of operating temperatures was experienced during the tests. Atmospheric temperatures ranged from 92° to -26° F. Official Minneapolis temperatures recorded by the U.S. Weather Bureau are shown in table 3.

Sample Analysis

Separate component analyses were made on each increment sample. The samples were weighed and the entire quantities analyzed in the Minneapolis laboratory of the Grain Division, C&MS.

RESULTS AND DISCUSSION

Lot Characteristics

Homogeneity

A separate laboratory analysis was made of each increment sample, and the component levels were plotted for each cycle of each lot. Typical curves of component levels for increment samples drawn in sequence from all samplers for cycles 1 to 4 are shown in figures 4 and 5. The curves for the four different samplers were in close agreement, and this was used as justification for pooling the data for the samplers and thereby treating samplers as replications.

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[2] Sourdock (Rumex crispus L.), peppergrass (Lepidium densiflorum Schrad.), Canada thistle (Cirsium arvense (L.) Scop.), Cockle (Silene sp.), Sheep sorrel (Rumex acetosella L.), barnyardgrass (Echinochloa crusgalli (L.) Beauv., Russian thistle (Salsola kali L.), Russian pigweed (Axyris amaranthoides L.), and pennycress (Thlaspi arvense L.).

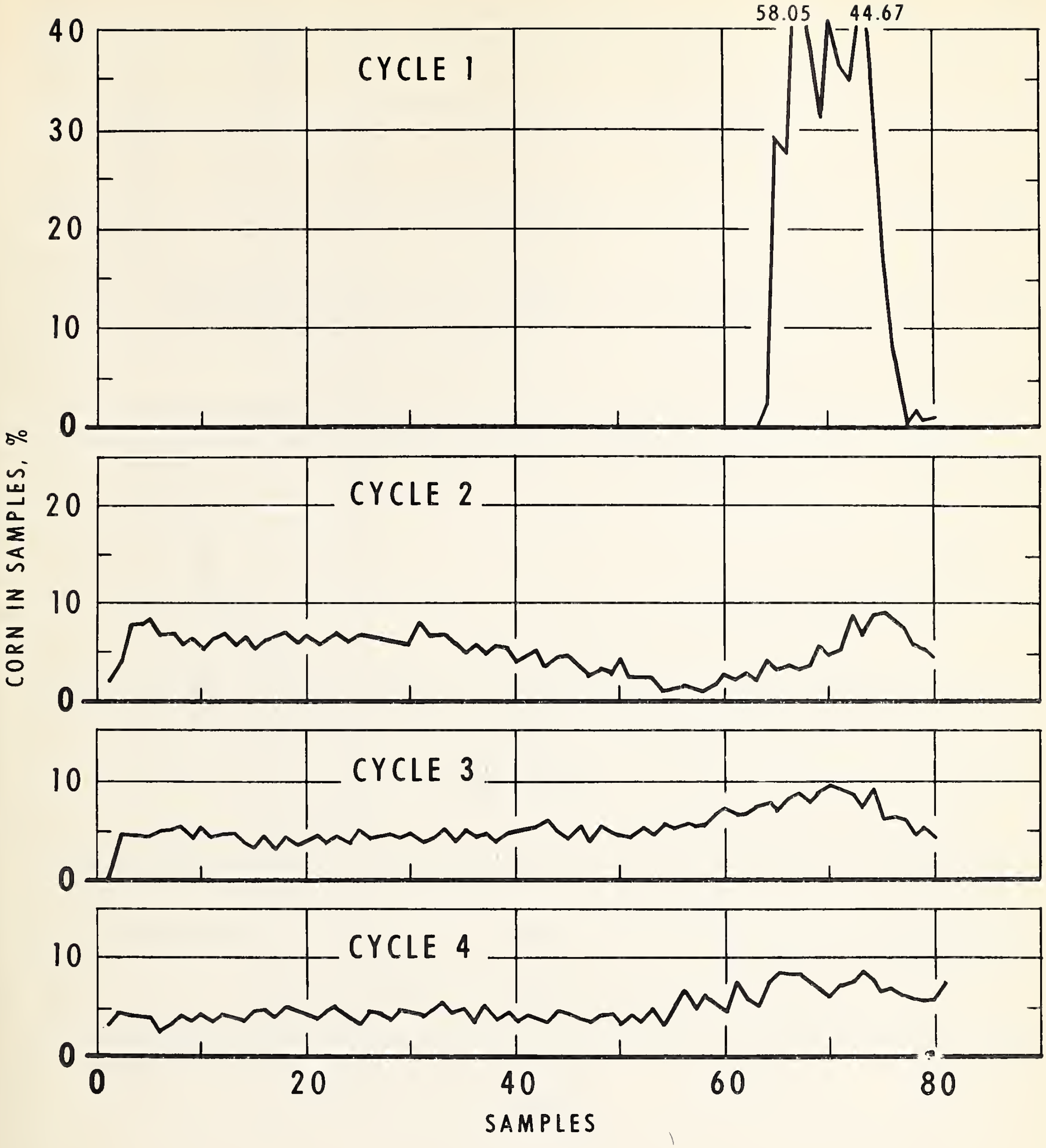

Figure 4.--Typical curves showing percentage of corn found in increment samples of wheat drawn during cycles 1 to 4.

Data from analyses of increment samples were used for calculating indexes of homogeneity for all lots by cycles. In this report, the index of homogeneity (μ) is the standard deviation divided by the mean, converted to a percentage. The lower the μ value the greater is the degree of homogeneity. Table 4 shows the combined and pooled standard deviations and the pooled homogeneity indexes for components in lots 1 to 12. The component homogeneity indexes for cycles 1 to 4 are plotted in figure 6.

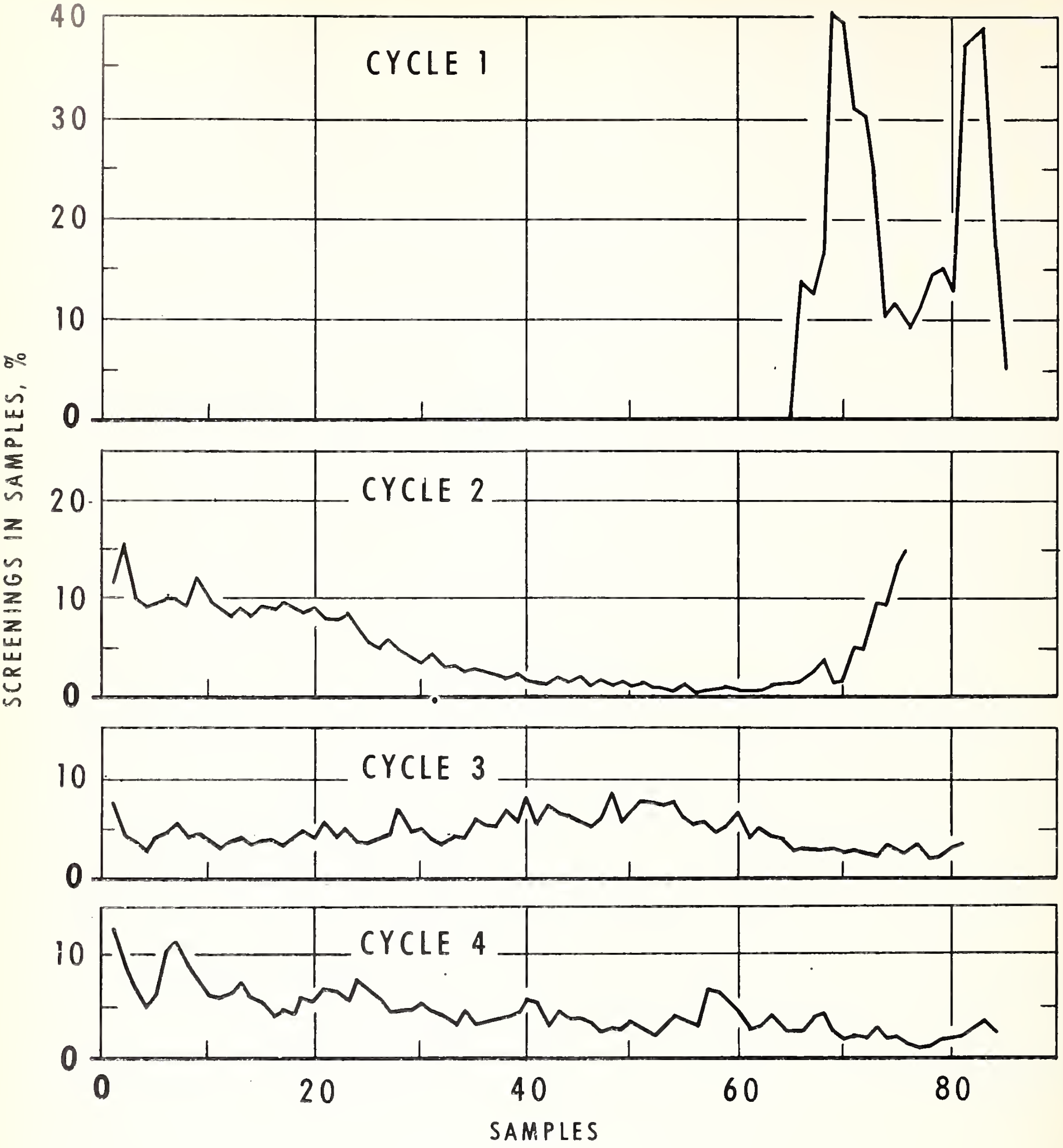

Figure 5.--Typical curves showing percentage of screenings found in increment samples of wheat drawn during cycles 1 to 4.

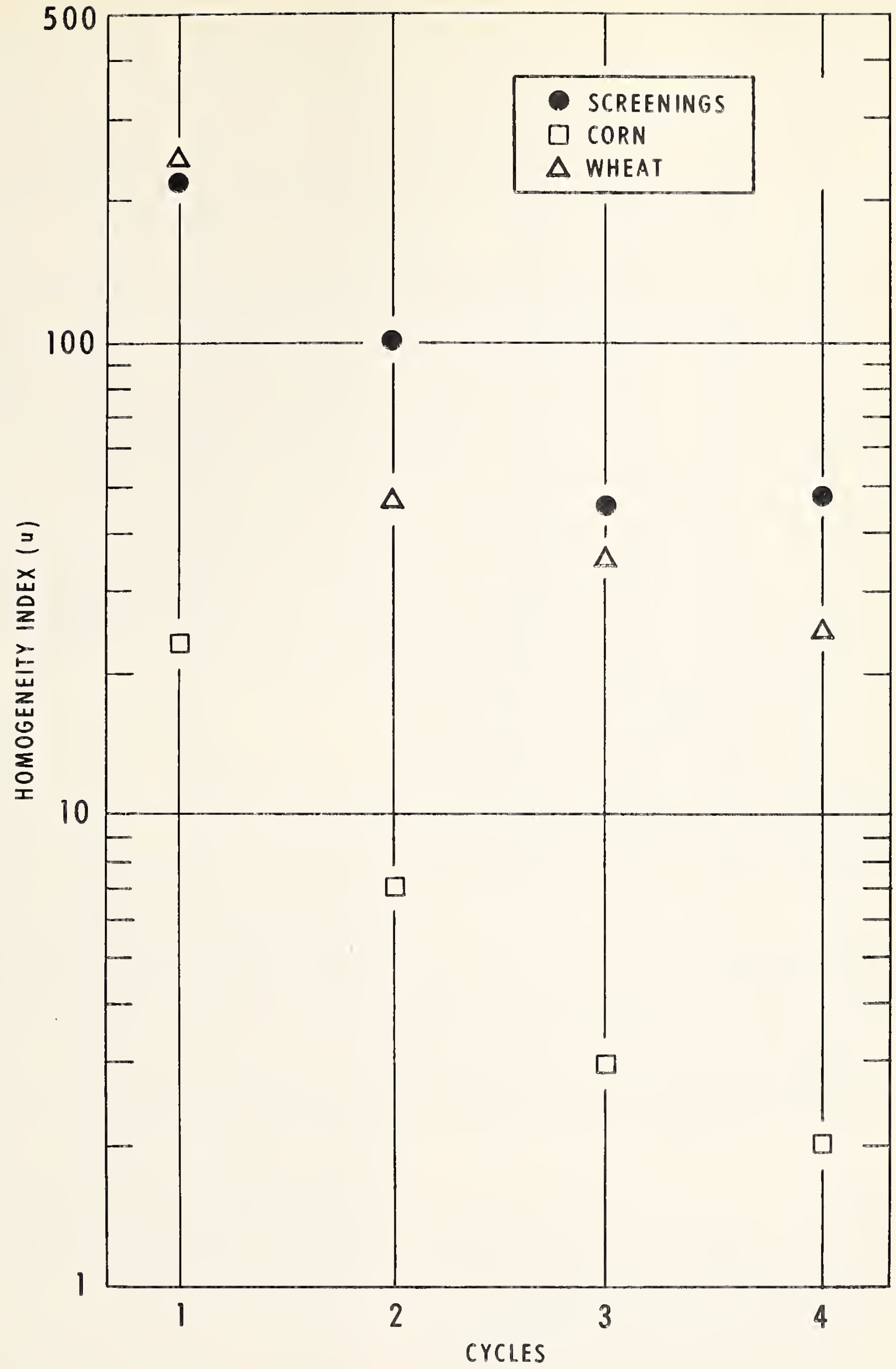

Figure 6.--Indexes of homogeneity of components in all lots of wheat, cycles 1 to 4.

The data in table 4 show that during cycle 1 the corn and screenings were distributed throughout the wheat in a very nonhomogeneous manner. The grain sampled during cycle 2 was found to be more homogeneous than in cycle 1. Mixing continued during cycles 3 and 4 with increased homogeneity for cycle 3 and little or no increase for cycle 4, except screenings in cycle 4 appeared to be less uniformly distributed than in cycle 3. A fifth and sixth cycling of lot 1 indicated no real increase in homogeneity after the fourth cycle. No significant differences were found in the homogeneity of lots sampled at 30° and 90° and at different flow rates.

The data show that repeated handling of a lot influenced homogeneity of the grain, but that good homogeneity was not reached even after six cycles. Homogeneity may reach a maximum and further handling may decrease uniformity because differences in the physical characteristics of the components may result in their stratification. The extent of the lot nonuniformity in these studies was such that after four cycles of handling one increment sample of corn, for example, drawn from the lot could be expected to deviate from the true mean of 4.97 percent by as much as ± 1.19 percent as often as one time in three.

Moisture Content

Moisture contents of samples drawn by the four samplers were identical, so far as could be determined by the measuring device used. Corn moisture percentage was 11.1; wheat moisture percentage was 10.4.

Test Weight

Average test weights between samplers were not significantly different (table 5). The test weights found by all samplers were averaged by cycles within lots and plotted in figure 7. The estimated average changes in test weight between lots were corn, + 0.02 lb./bu., wheat, + 0.23 lb./bu., and screenings, -0.79 lb./bu.

The same corn, wheat, and screenings were used for all 12 lots. Each lot was cycled a minimum of four times and received additional handling during sieving. A probable reason for the increased test weight of the wheat is that the frequent handling caused scouring, which removed a portion of the bran coat. The decrease in test weight of the screenings is probably caused by the light bran from the wheat mixing with and fluffing up the screenings.

Weight Loss Caused by Handling

The grain used in each cycle of each lot was weighed in the weigh buggy before being dropped into the upper bin. Figure 8 shows the individual weights by cycle and lot. Grain added or removed between lots, to adjust each new lot to 40,000 lb., was not included in these plotted weights. The average loss for each handling of a lot was approximately 20 lb. For the calculation of this loss, each cycle of sampling and each separation of a lot into its components was considered as one handling.

Sampler Performance

Sample Accuracy and Variability

Data for all samples drawn by the four samplers were tabulated, and the weights of corn, wheat, and screenings found in each small increment sample were totaled. These totals were used to calculate composite percentages for each cycle of the 12 lots. Table 6 shows these percentages and their averages by cycle, angle of spout, rate of grain flow, and position of sampler. It also shows the deviation of each sample's component percentage from the known lot percentage for that component. These deviations (for all cycles) have been plotted in figure 9. Little variation is shown in the frequency distribution between samplers.

The data in table 6 have been summarized in tables 7 and 8. Between samplers the agreement was good and the small differences shown are not significant at the 5-percent level. Sampler performance did not appear to be biased by position of sampler, spout angle, or grain flow rate.

Standard deviations for cycle 1 were significantly different from the other cycles.

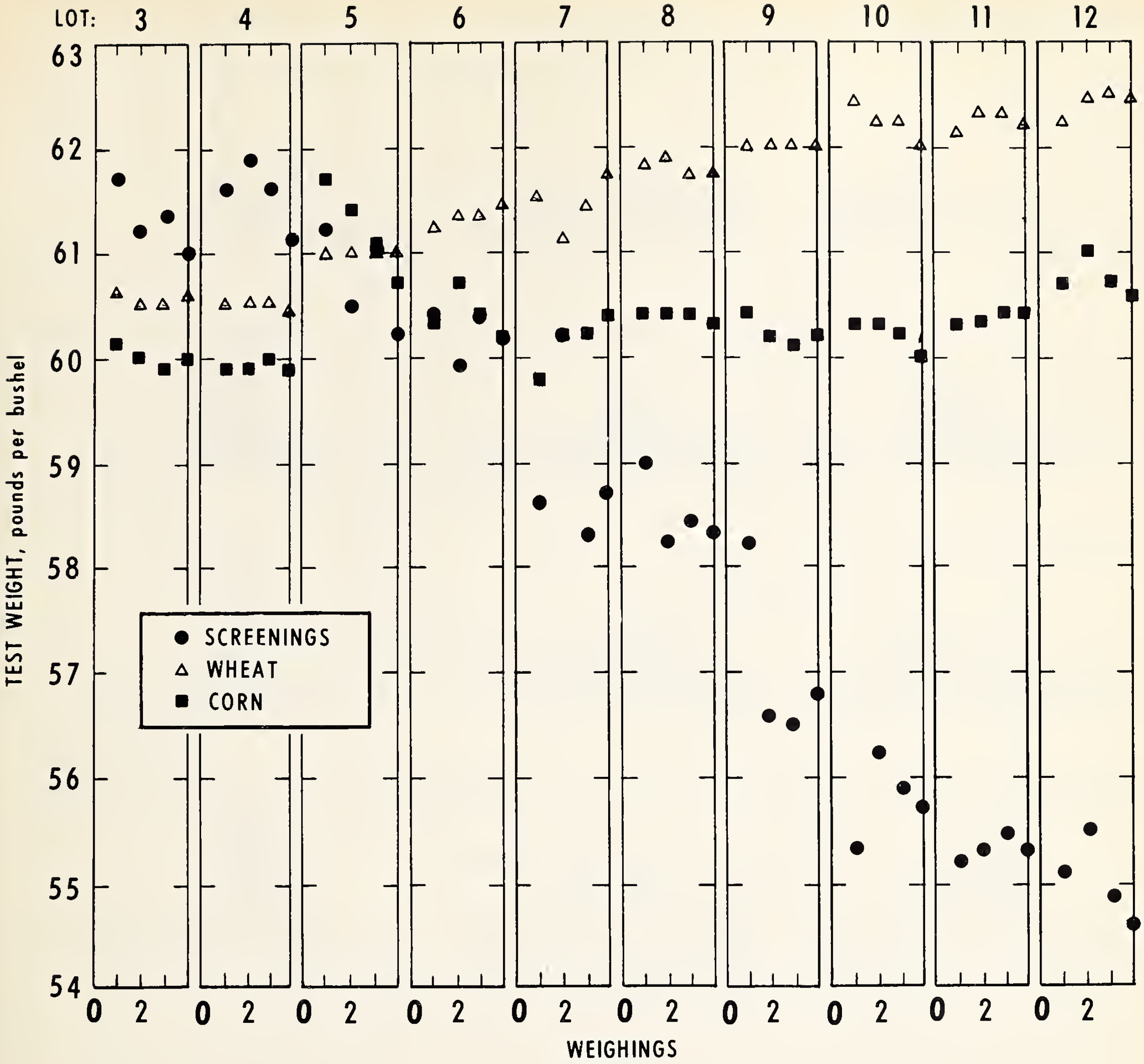

Figure 7.--Component test weights averaged by cycle within lots of wheat.

This can be attributed to the increased homogeneity of the grain in cycles 2, 3, and 4 due to handling.

Sampling Interval

After analysis, each increment sample was reconstituted and larger composites were made from every third increment sample of the series. For example, samples 1, 4, 7, ...16; 2, 5, 8, ...17; and 3, 6, 9, ...18 became composites 1, 2, and 3, respectively. These larger composites represented increment samples drawn from each 6,000 lb. of grain. A separate component analysis was made of each larger composite. The component analysis data representing each 2,000 lb. of grain were statistically analyzed to represent every third increment sample (every 6,000 lb.) drawn in sequence. These data were not significantly different from the data obtained from the recomposited samples representing 6,000 lb. of grain. This justified confidence in a statistical composite analysis representing every second, third, and fourth increment sample. These statistical

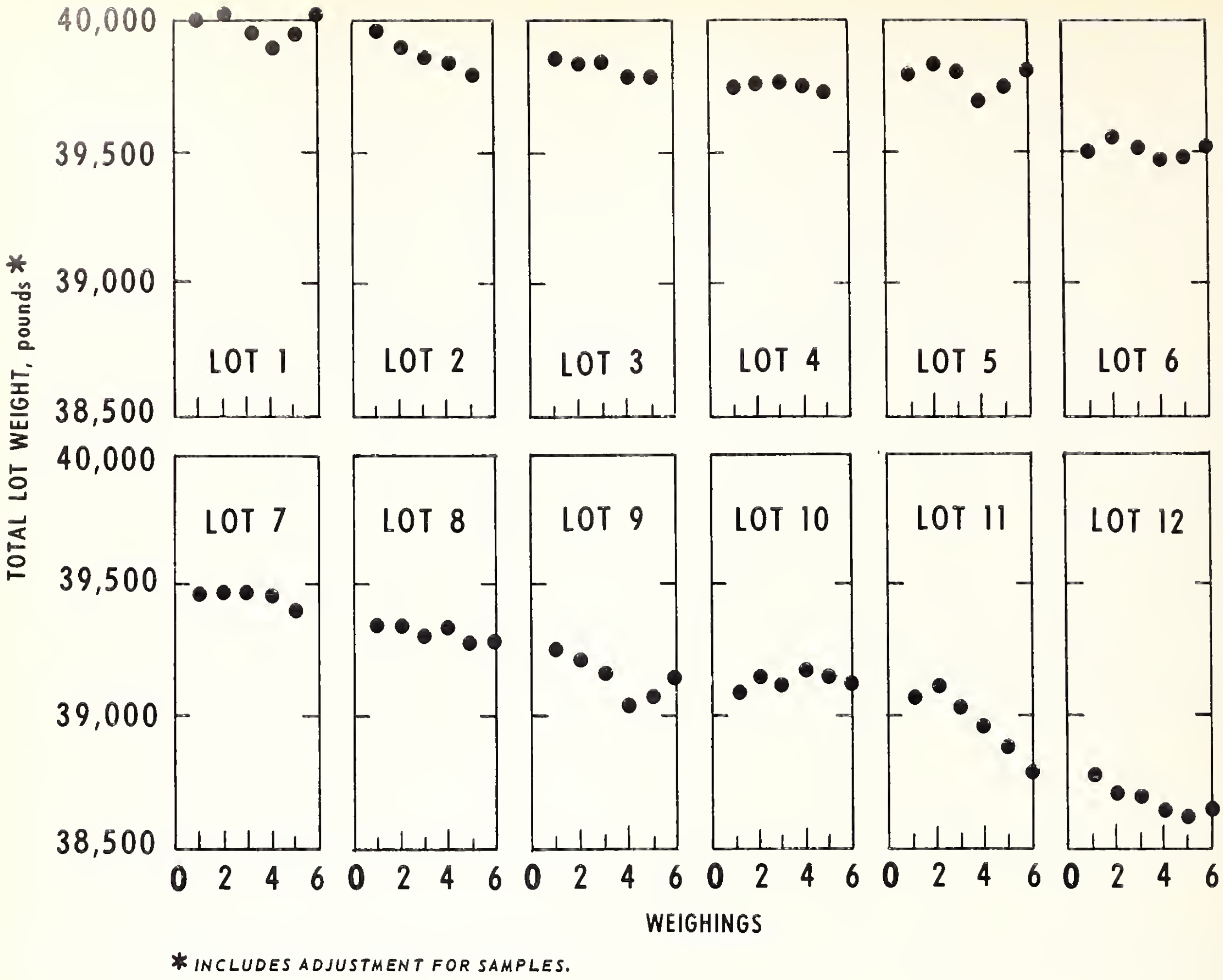

Figure 8.--Decrease in total lot weight caused by handling wheat.

composites represented increment samples drawn from each 4,000, 6,000, and 8,000 lb. of grain.

A standard deviation provides a measure of variability about the mean. The data in table 8 show standard deviations for each cycle of all lots by specific sampling device as well as the pooled standard deviation for the three mechanical samplers. Standard deviations decreased from cycle 1 to cycle 3 and decreased a little between cycles 3 and 4. The standard deviations for the pelican sampler generally were higher than for the mechanical samplers.

Table 9 summarizes findings for increment samples drawn from each 2,000 lb. of grain and the statistically computed findings for each 4,000, 6,000, and 8,000 lb. of grain in lots 1 to 12. These findings are illustrated by graph (fig. 10), which shows the true mean for each lot, the average mean found by the three mechanical samplers, and the 95-percent confidence range for any one increment sample. For example, the average percentage of corn found by the three mechanical samplers during cycle 4, drawing one increment sample from each 2,000 lb. of grain, was 4.93 percent. At a 95-percent confidence range of two standard deviations, we would not expect an increment sample to contain corn outside the range of 4.61 to 5.25 percent. Drawing one increment sample from each 8,000 lb. of grain, this expected range increases from 4.19 to 5.71 percent. Similar data for screenings are shown in figure 11.

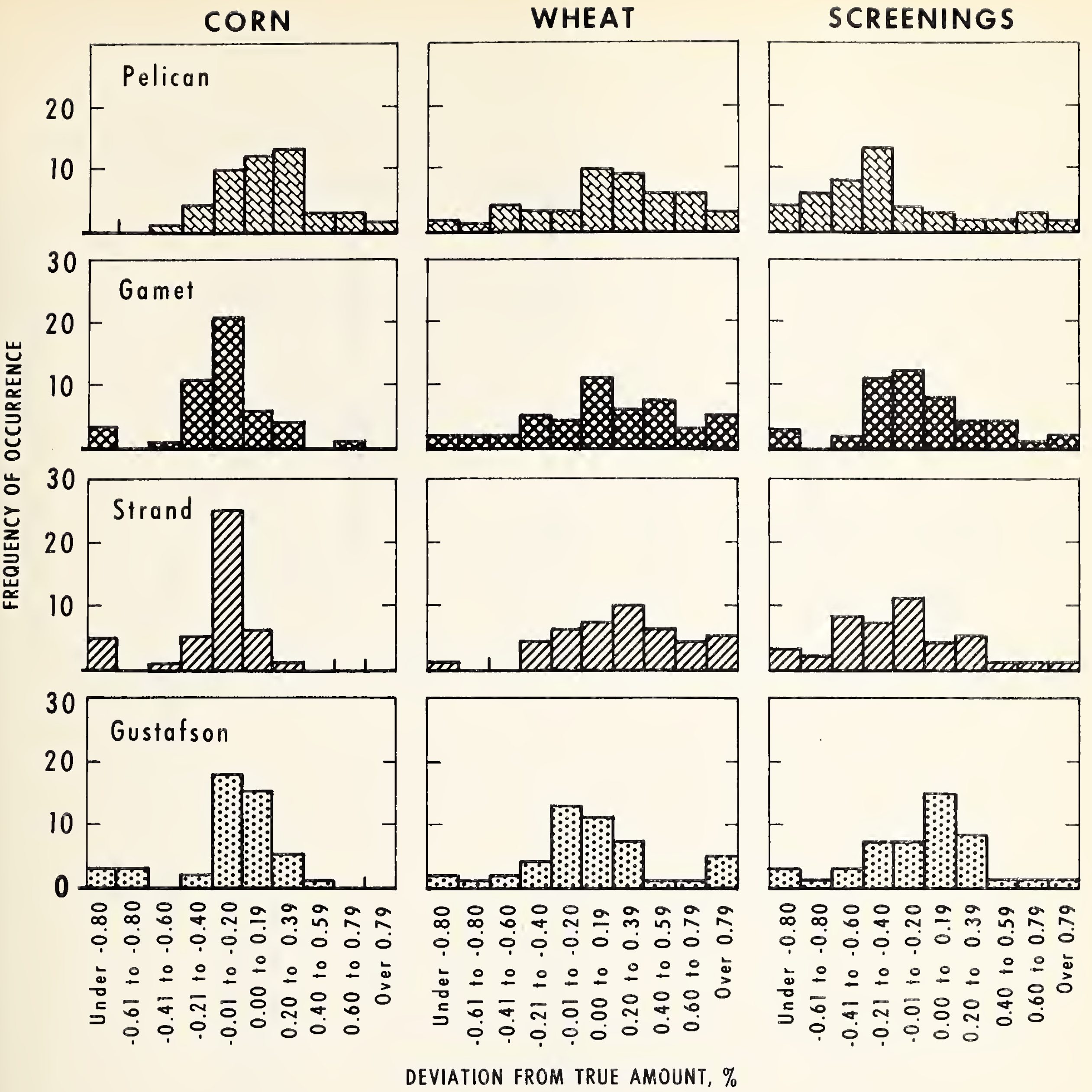

Figure 9.--Frequency distribution of deviations of percentages of components in wheat samples drawn by four samplers from true percentages of components in lots.

Sample Weights

Each increment sample drawn by the four samplers was weighed to the nearest 0.1 gram. The average increment weight, standard deviation, and index of homogeneity for the increment samples drawn by each sampler for each cycle of each lot are shown in table 10. The Gamet sampler was the least variable; the Gustafson and Strand had about equal variability.

Increment sample weights drawn from lots 1 to 12 were averaged by spout angle, rate of grain flow, and position of sampler and are shown in table 11. The smallest samples were drawn by the Strand, followed by the Gamet, pelican, and Gustafson. There was no consistency in the sample weight between

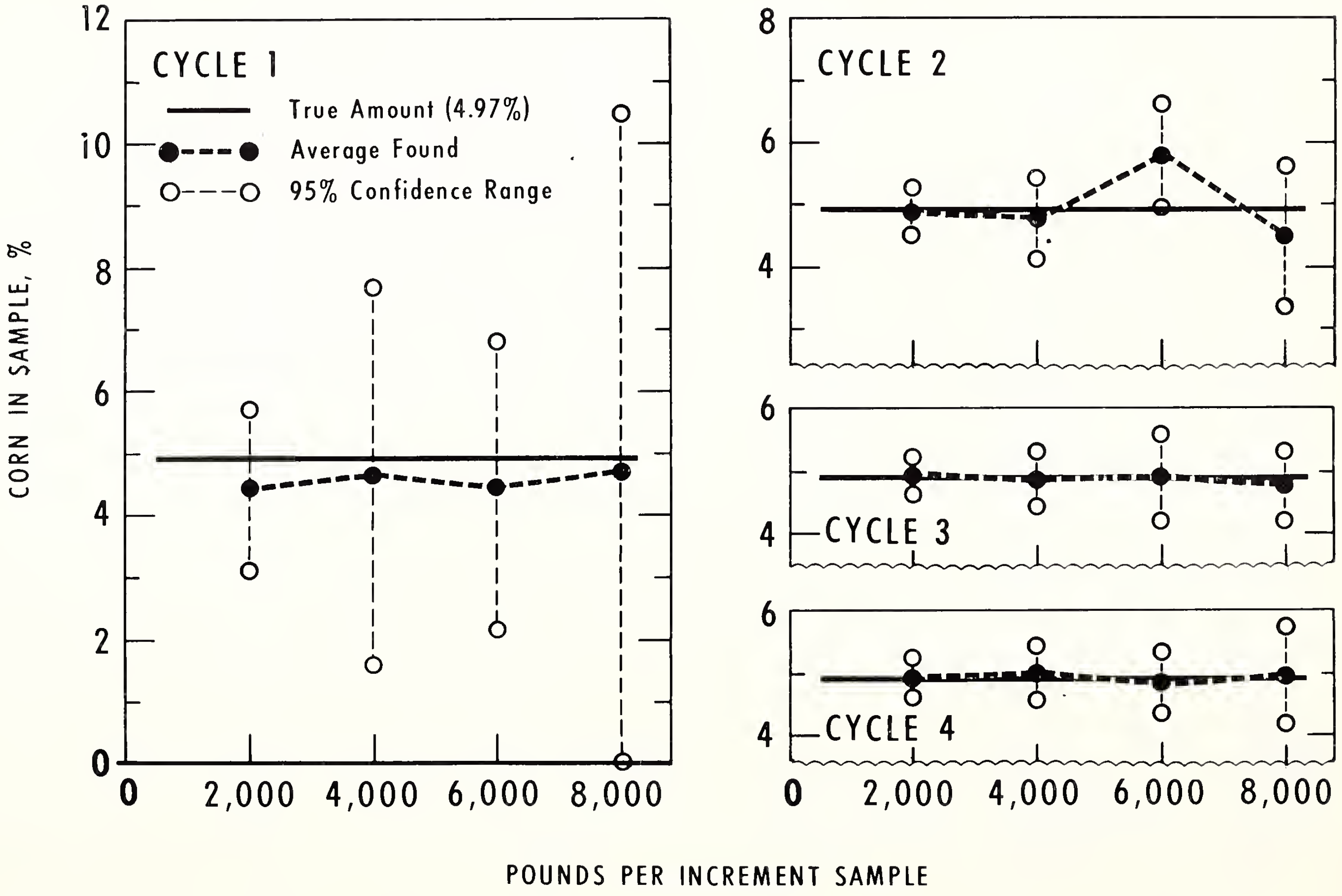

Figure 10.--Average percentage of corn and confidence range for composite samples drawn at several sampling frequencies.

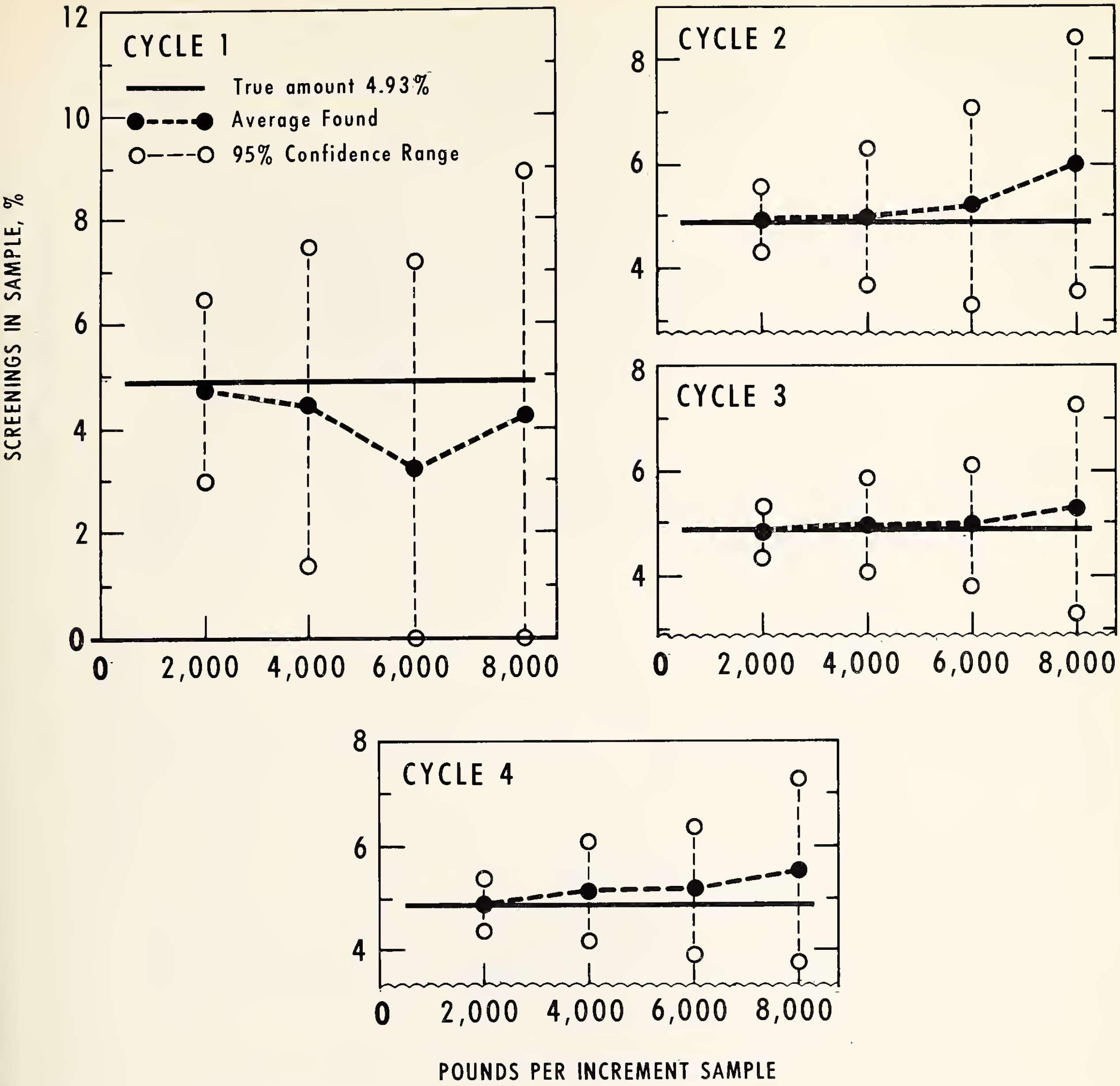

Figure 11.—Average percentage of screenings and confidence range for composite samples drawn at several sampling frequencies.

the mechanical samplers in relation to sampler position. Spout angle had little effect on sample weight.

Standard deviations for composite sample weights of the 12 lots are shown by sampler and cycle in table 12.

Sample Weight Versus Flow Rate

Flow rate of the wheat in pounds per minute for each cycle of each lot was determined by dividing the total weight of the wheat by the time required for the wheat to flow through the samplers. The average increment sample weight drawn by the four sampling devices is shown in table 13.

An analysis of variance showed the ratios of flow rate to sample weight were not significantly different for the 30° and 90° sampling angles. The ratio of sample weight to flow rate was significantly larger for the 2,000 lb./min. flow rate than for the 4,000 (figs. 12 to 15). This was true for all four samplers. Sample weight did not vary directly with flow rate as might be expected.

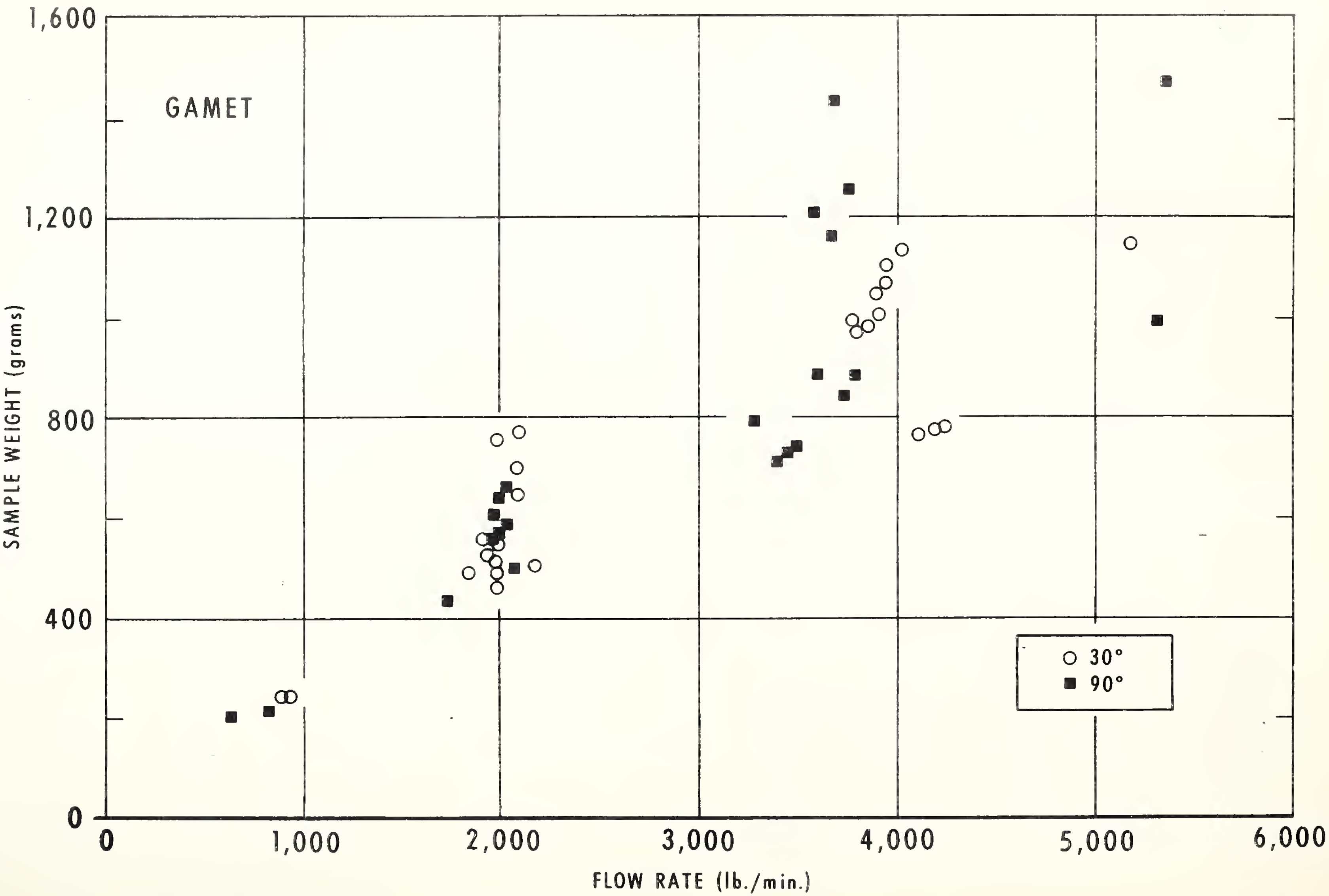

Figure 12.--Average weight of increment samples of wheat drawn by Gamet sampler with two spout angles and several flow rates.

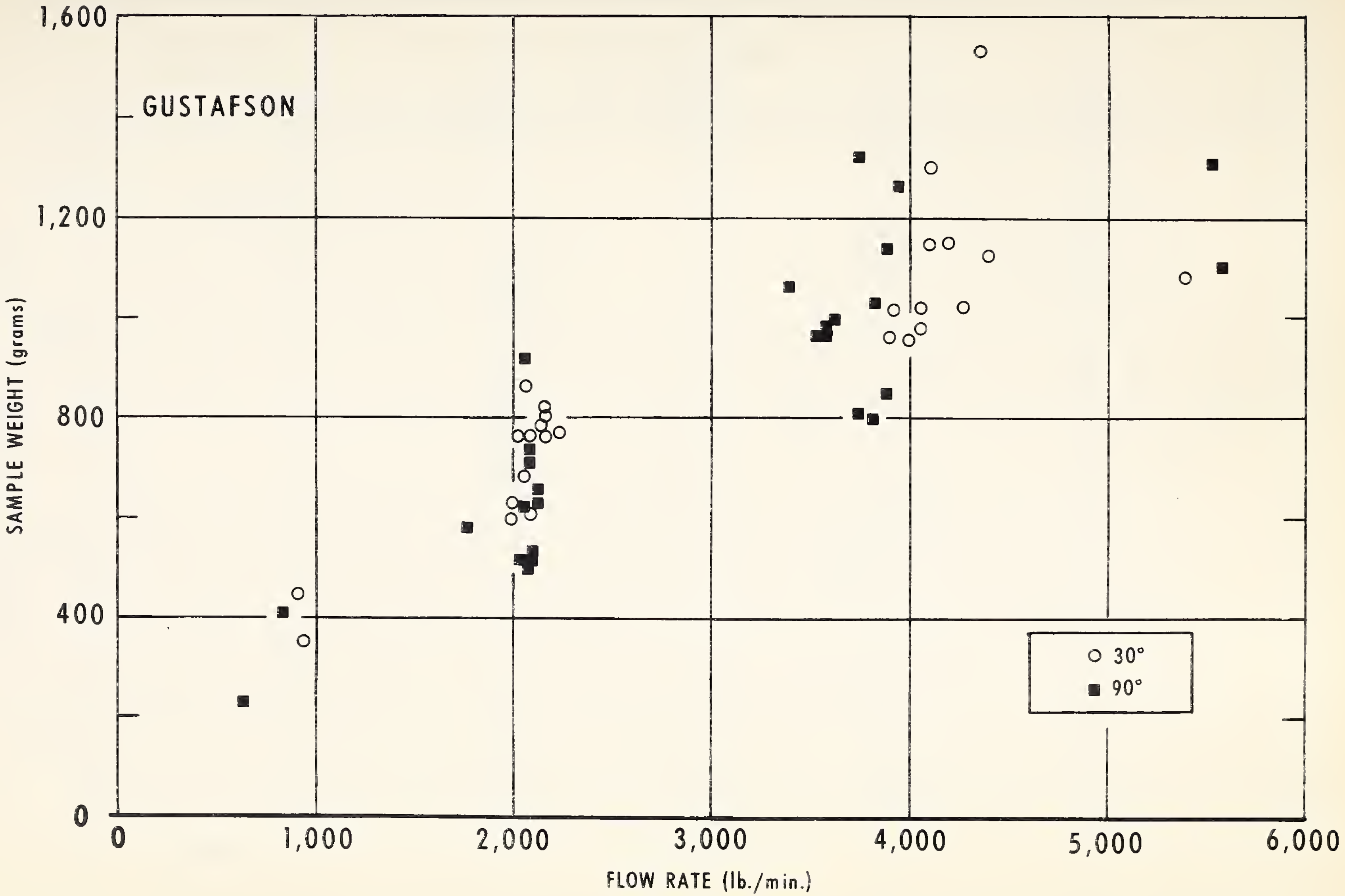

Figure 13.--Average weight of increment samples of wheat drawn by Gustafson sampler with two spout angles and several flow rates.

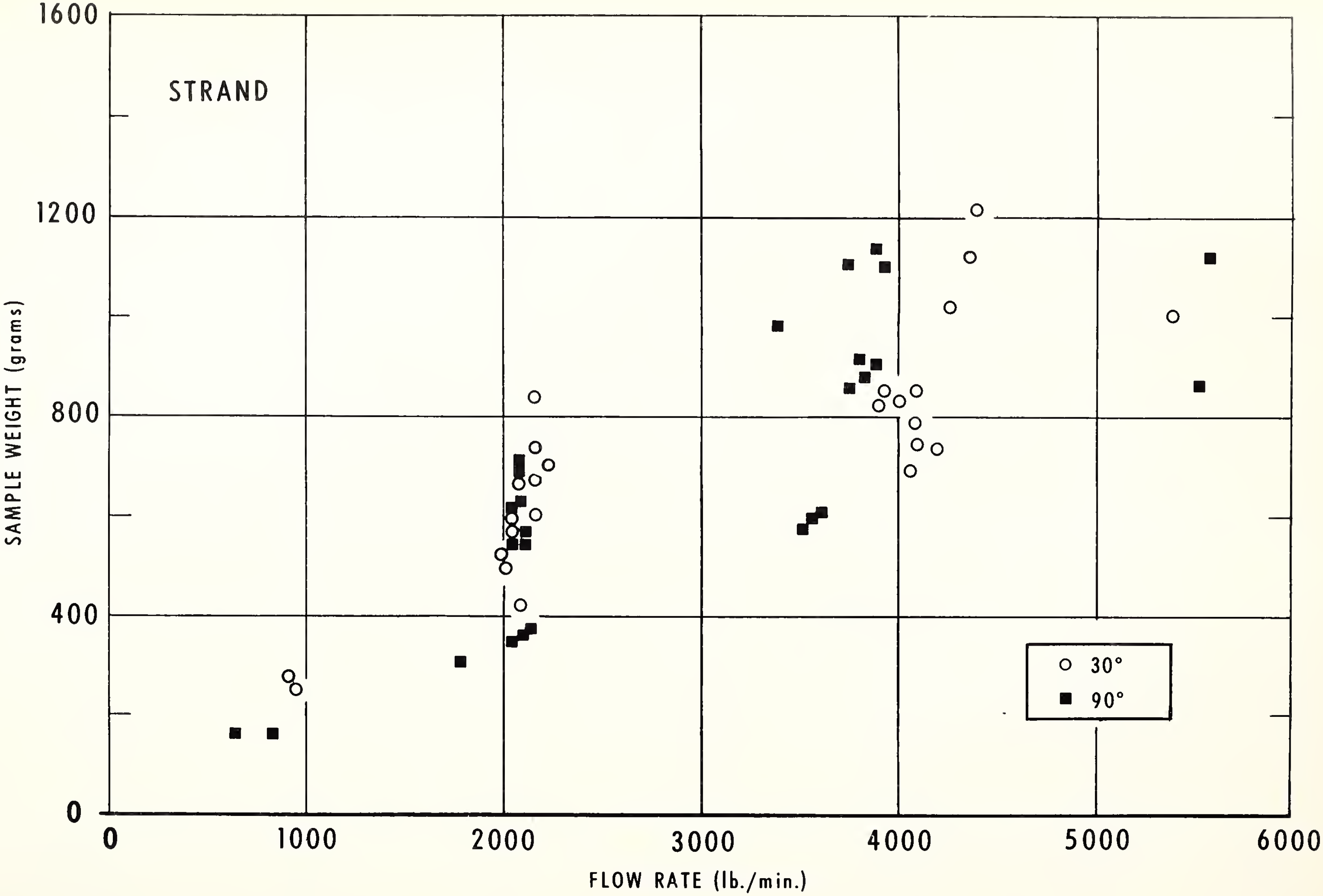

Figure 14.--Average weight of increment samples of wheat drawn by Strand sampler with two spout angles and several flow rates.

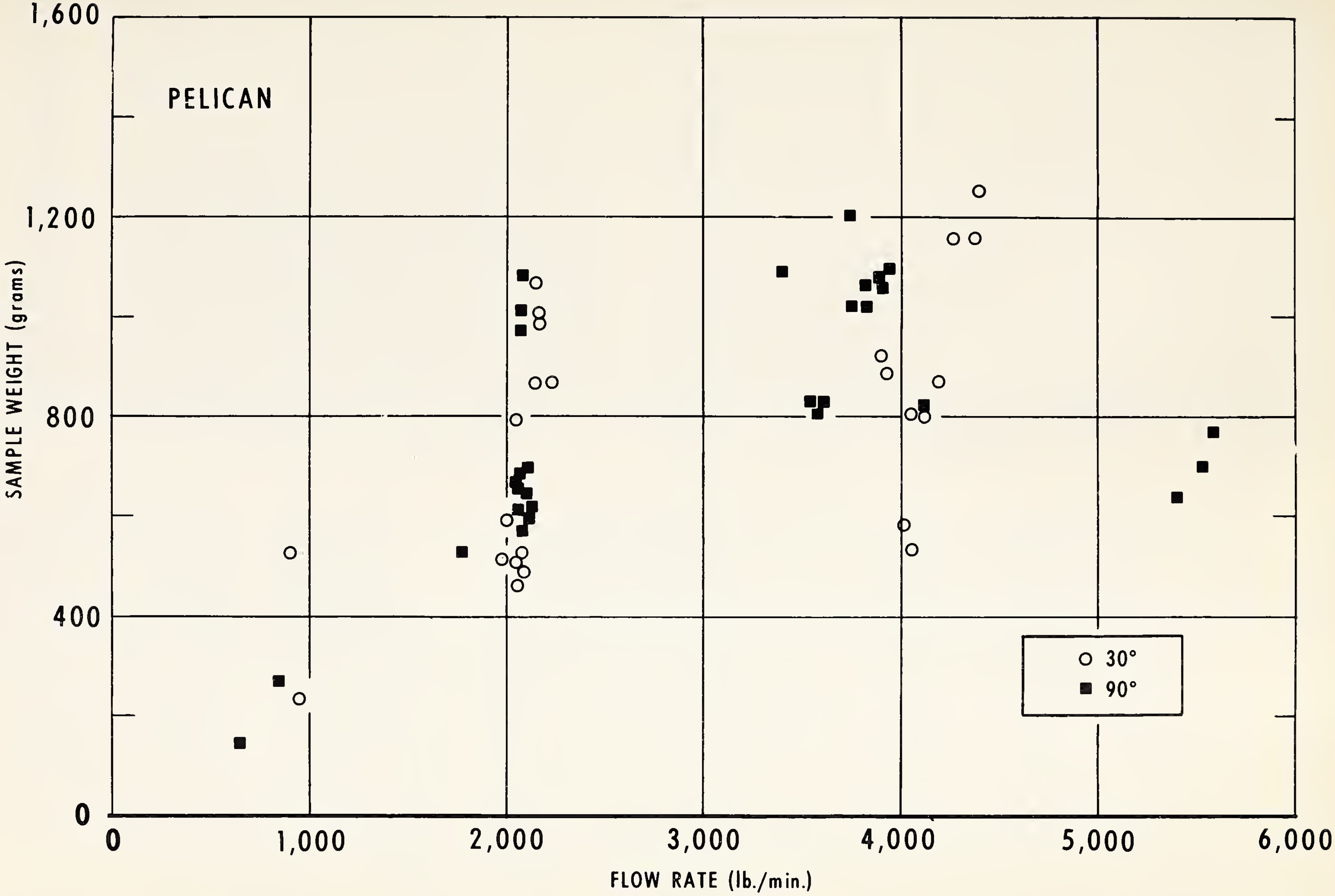

Figure 15.--Average weight of increment samples of wheat drawn by Pelican sampler with two spout angles and several flow rates.

Effect of Diverter Travel Direction on Increment Sample Weights

The three diverter-type samplers each traversed the grain stream alternately from left to right and right to left. Assuming no contributing variables, direction of travel should not influence weight of increment samples drawn. The average weights of the odd-numbered increment samples and the even-numbered increment samples in each cycle of each lot were ascertained for each sampler. The lighter of the two averages is expressed as a percentage of the heavier average in table 14.

Samples drawn by the Gamet sampler were least influenced by direction of diverter travel, followed by the Gustafson and the Strand.

One variable expected to contribute to sample weight differences is average velocity of the diverter in traversing the grain stream. Each mechanical sampler was intended to have the same diverter velocity in both directions, but this ideal was not always maintained throughout a sampling sequence. The Strand and Gustafson samplers were powered by pneumatic cylinders. The average velocity of their diverters may have been influenced by variations in mechanical resistance, friction, and air pressure. The Gamet sampler was powered by an electric motor-driven gear reducer, which reversed direction for each traverse. Its diverter velocity was controlled by gear ratio and motor r.p.m.

Mechanical Performance

The duration of this research was not sufficient for an adequate evaluation of the three mechanical samplers for mechanical dependability and durability under constant use. However, a record was kept of mechanical problems encountered.

During cycles 1 to 4 of lot 1 the flow of grain from the outlet of the Strand sampler appeared to be sluggish. The spout angle was 30° from horizontal, and paint on the interior probably caused sufficient friction to restrict free flow of grain past the diverter. The Strand sampler drew an excess of screenings during all cycles of lot 1. Therefore, data obtained on the Strand sampler for lot 1 were not used. After cycle 4 of lot 1 the paint was worn off and the flow of grain through the sampler appeared normal. These observations and published data on friction of grain on various surfaces[3] indicate that a spout angle of 30° is about the minimum slope at which mechanical samplers should be operated.

During cycle 2 of lot 1 the ninth increment sample drawn by the Strand sampler was abnormally large. Apparently, the diverter remained partially in the grain stream for approximately 15 seconds. Operation appeared normal during cycles 3 and 4, but trouble developed during cycle 5. Cycle 5 was abandoned and the manufacturer reinforced the sampler housing. A sixth cycle was performed, during which the sampler performed satisfactorily.

During cycle 1 of lot 7 the Gamet sampler blew a fuse after about 30 seconds of grain flow. The fuse was replaced and the cycle continued for about 90 seconds when the fuse again blew. After being cleared of all grain and operated without grain flow, indications of binding in the diverter mechanism were noted. The Gamet representative returned the sampler to the company's shop for inspection.

After reinstallation of the Gamet sampler, cycle 1 was resumed for 6 min. and 35 sec., when malfunctioning was again noted and the cycle was terminated with about 1,500 lb. of the lot remaining in the upper bin. The sampler was returned to the Gamet shop and the d.c. motor was replaced with an a.c. motor. Shims were removed from between the diverter and its circular drive plate to attain a tighter fit. A metal wiper plate was added to each side of the diverter to reduce the possibility of grain lodging under the diverter, which was assumed to have caused binding. The remaining cycles of lot 7 and of lots 8 to 12 were completed without further mechanical difficulty.

During cycle 3 of lot 6 the ninth increment sample drawn by the Gustafson sampler was abnormally large because of a momentary malfunction of the diverter. During cycles 2, 3, and 4 of lot 7 both the Strand and

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[3] American Society of Agricultural Engineers. Friction coefficients of grain. Agr. Engin. Yearbook, ASAE Data 242, p. 282. 1966.

Gustafson samplers operated somewhat erratically and sluggishly in the subzero cold that prevailed during that period. During cycle 3 of lot 8 the diverter of the Gustafson appeared to hesitate in the middle of each traverse of the grain stream. Subzero temperature was the probable cause.

"Standard" Pelican Versus "Check" Pelican Samples

Pelican samples were drawn by two different sampling techniques. "Standard" pelican samples were drawn by swinging the pelican horizontally from right to left across the grain stream. This is the customary technique used by grain inspectors.

"Check" pelican samples were drawn by swinging the pelican through the grain stream from the far side toward the near side of a vertical stream, and from below to the top of a grain stream flowing at 30° from the horizontal.

A comparison of the results is shown in table 15. There was little difference in the component analysis of the samples drawn by the two techniques.

Laboratory Analysis Error

The performance of a sampling device can be evaluated by comparing the contents of the sample with the true contents of the entire lot from which the sample was drawn. This has been done in the data discussed previously. However, a valid comparison of a sample with the lot depends on an accurate laboratory analysis of the sample.

An estimate of the accuracy of the laboratory analysis was obtained by using coded samples of typical weight and composition. Samples consisting of 600 and 900 grams were replicated six times and then submitted for analysis. Each sample had the following component percentages:

Corn Percent	Wheat Percent	Screenings Percent
2	86	12
4	86	10
6	86	8
8	86	6
10	86	4
12	86	2

The results of these analyses show that the laboratory could repeat itself 98 times in 100 to within ± 0.10 percent for corn and ± 0.05 percent for screenings. This error was independent of the percentage of corn or screenings actually in the sample for the range of 2 to 12 percent.

The distribution of the corn, wheat, and screenings analysis error is shown in figure 16.

Secondary Sampling

The entire contents of all samples drawn by the four sampling devices were analyzed for their component percentages. After each sample had been analyzed, the sample was reconstituted and became available for additional research. The entire sample was analyzed to avoid error that might be introduced if the sample weight was reduced before analysis.

Sample weights routinely analyzed in a grain inspection laboratory are approximately 1,000 grams. Therefore, the reconstituted samples were cut down to approximately 1,000 g., using a model No. 344 official Boerner Sampler. The cut-down samples were analyzed by the same equipment and procedure used for their respective total samples. A summary of the comparative component percentages for the 584 pairs of samples is shown in table 16 and the frequency distribution differences between the total and cut-down samples are shown in figure 17.

The data in table 16 show there were no significant differences between the overall averages for the 584 pairs of samples. The

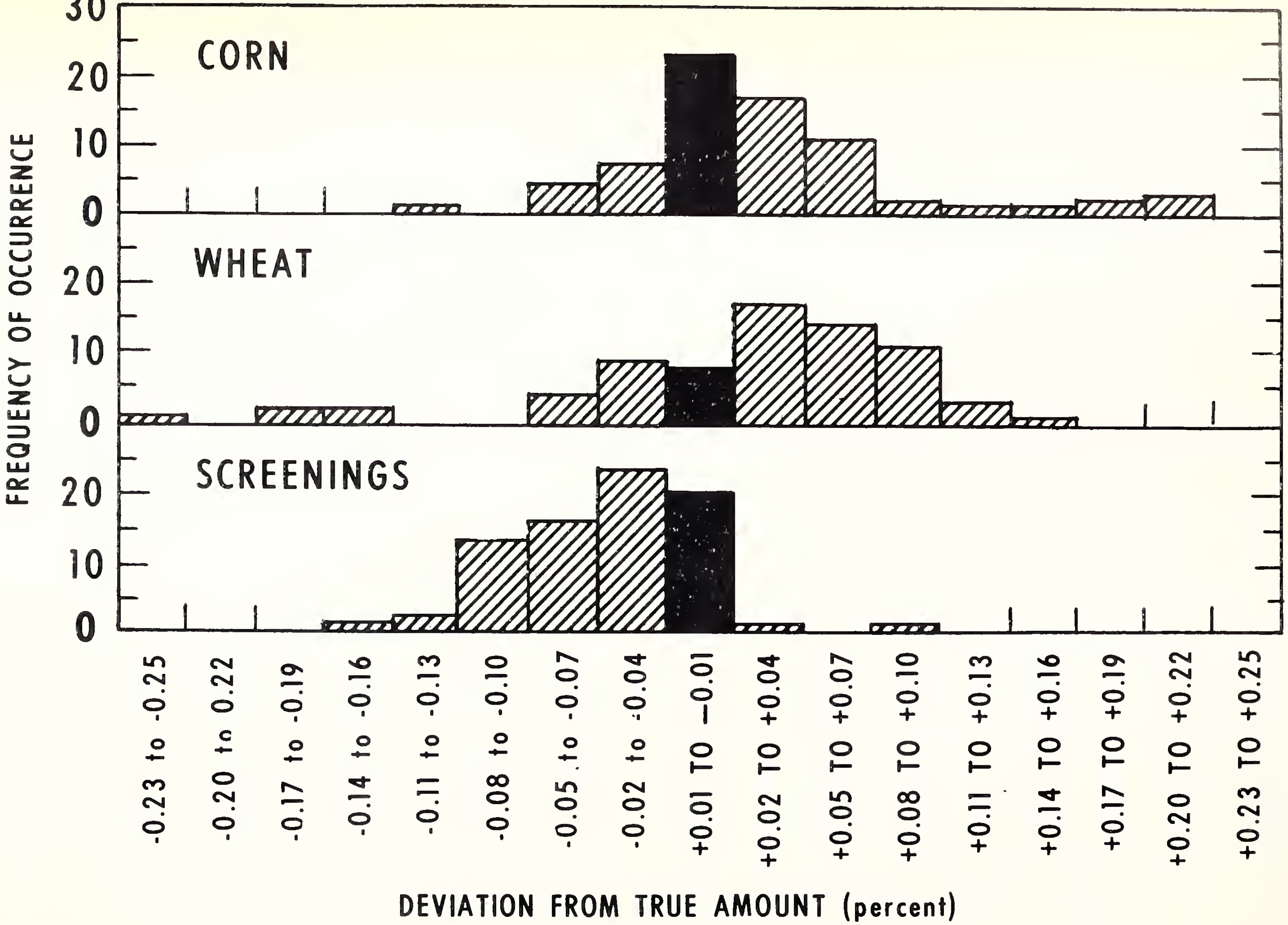

Figure 16.--Frequency distribution for differences in percentage of components found in the samples and the true percentage present in the samples.

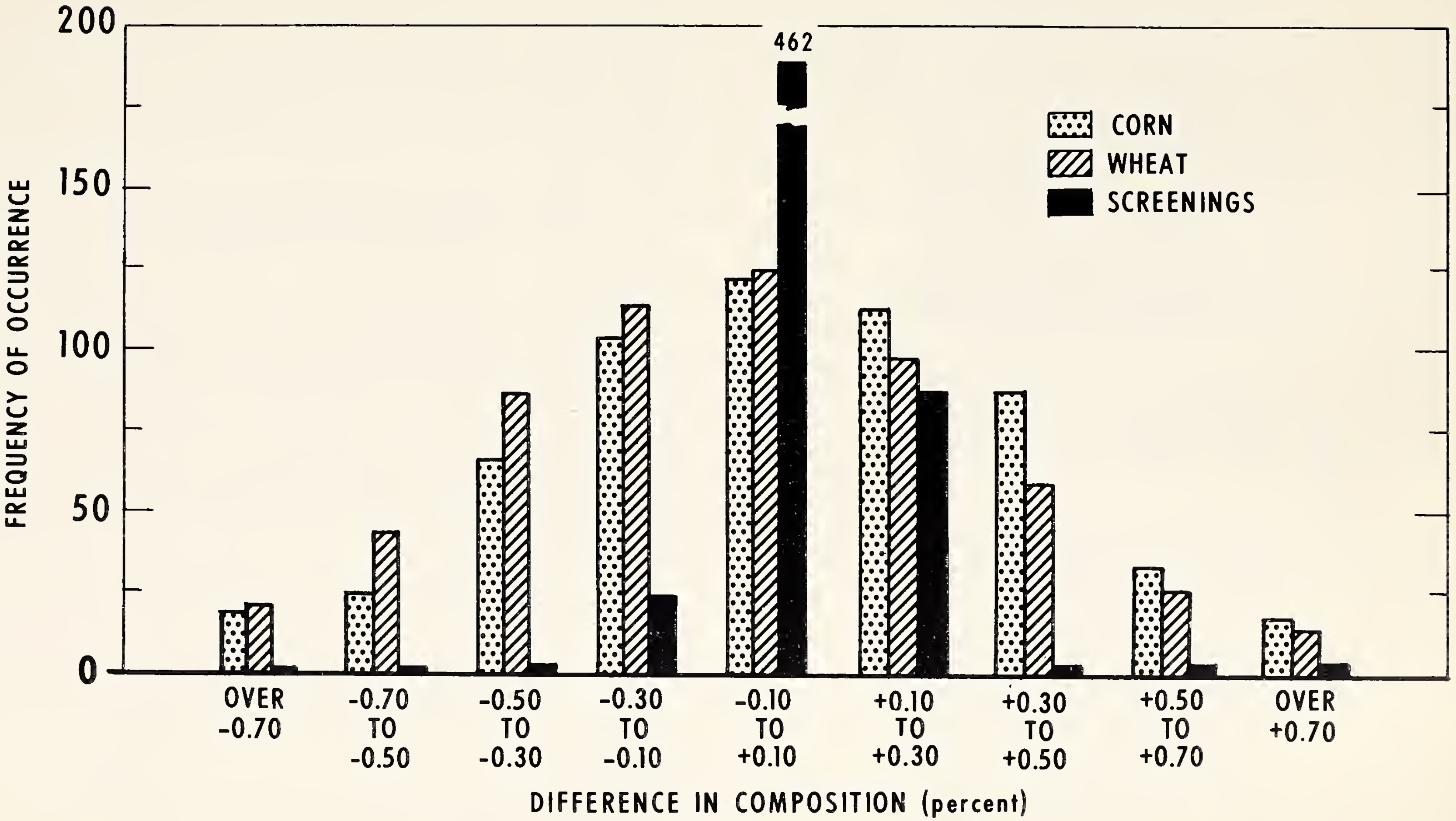

Figure 17.--Frequency distribution of differences in percentage of components found in the total samples and in the samples "cut down" to about 1,000 grams.

standard deviation shows the range of error that was introduced by cutting the large samples down to about 1,000 g. Using corn as an example and a confidence level of 95 percent (two standard deviations), one could not expect any one cut-down sample to differ more than ± 0.72 percent (2 x 0.39) from its total sample more often than 5 times in 100.

SUMMARY

Three diverter-type mechanical samplers were installed and tested under conditions simulating country elevator operations. The tests included two grain flow rates, two spout slopes, three sampler locations, and four levels of homogeneity. Performance of the three mechanical devices and a pelican sampler were compared using wheat containing known percentages of corn and screenings. Component levels exceeding normal levels found in market channels were used to provide a challenge for the sampling devices. Both accuracy and variability could be expected to improve at lower component levels.

In overall performance the three mechanical samplers did not differ significantly. They were not biased by flow rate, spout angle, or position along the spout within the conditions of the tests. The pelican performed as well as the mechanical devices, but samples drawn by it were slightly more variable.

Handling during the testing procedure caused a rapid increase in the homogeneity of layered grain but did not result in a mixture approaching complete homogeneity.

TABLE 1.--Sampling plan followed for the 12 lots of wheat

Lot	Spout angle	Grain flow rate	Sampler position[1]			
			Upper	Middle	Lower	Last
	Degrees	Lb./min.				
1..........	30	2,000	Ga	Gu	St	P
2..........	30	4,000	Ga	Gu	St	P
3..........	90	4,000	Ga	Gu	St	P
4..........	90	2,000	Ga	Gu	St	P
5..........	90	2,000	Gu	St	Ga	P
6..........	90	4,000	Gu	St	Ga	P
7..........	30	4,000	Gu	St	Ga	P
8..........	30	2,000	Gu	St	Ga	P
9..........	30	2,000	St	Ga	Gu	P
10..........	30	4,000	St	Ga	Gu	P
11..........	90	4,000	St	Ga	Gu	P
12..........	90	2,000	St	Ga	Gu	P

[1] Ga-Gamet
Gu-Gustafson
St-Strand
P-Pelican

The pelican was always at the end of the spout.

TABLE 2 .--Weight and percentage of total weight of components of 12 lots of wheat recovered after sieving.

Lot	Weight				Percentage of total weight			
	Corn	Wheat	Screenings	Total	Corn	Wheat	Screenings	Total
	Lb.	Lb.	Lb.	Lb.	Pct.	Pct.	Pct.	Pct.
1..............	1,973	36,043	1,939	39,955	4.94	90.21	4.85	100
2..............	1,989	35,951	1,945	39,885	4.99	90.14	4.87	100
3..............	1,991	35,938	1,967	39,896	4.99	90.08	4.93	100
4..............	1,997	36,084	1,956	40,037	4.99	90.12	4.89	100
5..............	1,963	35,840	1,942	39,745	4.94	90.17	4.89	100
6..............	1,971	36,003	1,968	39,942	4.93	90.14	4.93	100
7..............	1,993	35,911	1,969	39,873	5.00	90.06	4.94	100
8..............	1,987	35,905	2,014	39,906	4.98	89.97	5.05	100
9..............	1,981	35,870	1,984	39,835	4.97	90.05	4.98	100
10..............	1,984	36,029	1,973	39,986	4.96	90.10	4.94	100
11..............	1,968	35,795	1,953	39,716	4.96	90.13	4.91	100
12..............	1,983	35,870	1,970	39,823	4.98	90.07	4.95	100
Average.......	1,982	35,936	1,965	39,883	4.97	90.10	4.93	100

TABLE 3.--Atmospheric temperatures[1] during the sampling of 12 lots of wheat

Lots and date of sampling	Cycle	Maximum	Minimum
		° F.	° F.
Lot 1:			
June 30	1 and 2	74	51
July 1	3	84	58
July 2	4	77	61
July 7	6	85	52
Lot 2:			
July 20	1 and 2	78	62
July 22	3 and 4	92	69
Lot 3:			
August 2	1 and 2	79	53
August 9	3 and 4	86	54
Lot 4:			
August 19	1 and 2	78	53
August 26	3 and 4	80	57
Lot 5:			
January 10	1 and 2	10	-1
January 12	3 and 4	23	14
January 13	5	20	9
Lot 6:			
January 17	1 and 2	9	-12
January 19	3 and 4	17	-6
January 20	5	15	-6
Lot 7:			
January 24	1	2	-16
January 27	2 and 3	-8	-21
January 28	4	-15	-26
Lot 8:			
February 1	1 and 2	18	-3
February 2	3 and 4	22	-7
February 3	5	18	-1
Lot 9:			
February 7	1 and 2	36	19
February 9	3 and 4	52	34
February 10	5	37	25
Lot 10:			
February 14	1 and 2	28	6
February 16	3 and 4	10	-10
February 17	5	9	-15
Lot 11:			
February 21	1 and 2	13	-10
February 23	3 and 4	26	6
February 24	5	38	10
Lot 12:			
February 28	1 and 2	43	34
March 2	3 and 4	41	33
March 3	5	43	36

[1] Official Minneapolis temperatures recorded by the U.S. Weather Bureau.

TABLE 4.--Standard deviations and homogeneity indexes for percentages of components in 12 lots of wheat, by cycle, spout angle and grain flow rate

Component and cycle	30° spout angle[1]		90° spout angle[1]		Pooled standard deviation[2]	Homogeneity index[3]
	2,000 lb. per min.	4,000 lb. per min.	2,000 lb. per min.	4,000 lb. per min.		
Corn:[4]						
Cycle 1.............	12.24	12.50	12.32	12.27	12.32	248
Cycle 2.............	2.62	2.37	3.02	2.22	2.31	46
Cycle 3.............	1.63	1.78	1.77	1.72	1.72	35
Cycle 4.............	1.03	1.12	1.32	1.31	1.19	24
Wheat:[4]						
Cycle 1.............	21.37	20.39	20.35	19.47	20.44	23
Cycle 2.............	6.77	6.43	5.98	5.99	6.30	7
Cycle 3.............	2.72	2.25	2.21	2.19	2.35	3
Cycle 4.............	2.19	2.17	2.06	2.09	2.13	2
Screenings:[4]						
Cycle 1.............	12.90	10.22	10.62	10.07	11.12	226
Cycle 2.............	4.95	4.73	5.11	4.67	4.87	99
Cycle 3.............	2.28	1.83	2.21	1.83	2.05	42
Cycle 4.............	2.08	2.37	2.46	2.28	2.30	47

[1] Combined standard deviation; calculated by using all increment sample data for all samplers.

[2] Calculated by using all increment sample data for all samplers and for all angle and flow rate combinations.

[3] Calculated by dividing the pooled standard deviation by the pooled mean and multiplying by 100.

[4] Actual component levels in lot: Corn, 4.97 percent; wheat, 90.10 percent; and screenings, 4.93 percent.

TABLE 5.--Average test weight of the corn, wheat, and screenings drawn by the four samplers from lots 3 to 12[1] of wheat

Sampler	Corn	Wheat	Screenings
	Lb./bu.	Lb./bu.	Lb./bu.
Gamet..................	60.4	61.6	58.7
Strand.................	60.4	61.6	59.2
Gustafson..............	60.4	61.5	58.5
Pelican................	60.3	61.5	60.3
Average...........	60.4	61.5	59.2

[1] No data were obtained for lots 1 and 2.

TABLE 6.--Percentage of corn, wheat, and screenings found in lots 1 to 12 of wheat by four samplers and deviation from component in original lot, by sampler and cycle

[One increment sample per 2,000 lb. of grain]

Sampler, component, and lot no.	Angle of spout	Grain flow rate	Sampling device position	Cycle 1		Cycle 2		Cycle 3		Cycle 4	
				Component in sample	Deviation from lot percentage	Component in sample	Deviation from lot percentage	Component in sample	Deviation from lot percentage	Component in sample	Deviation from lot percentage
GAMET		Lb./min.		Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Corn:[1]											
Lot 1............	30°	2,000	Upper	3.03	-1.94	4.58	-0.39	4.77	-0.20	4.69	-0.28
Lot 9............	30°	2,000	Middle	4.79	-.18	5.31	+.34	5.17	+.20	5.00	+.03
Lot 8............	30°	2,000	Lower	3.57	-1.40	4.94	-.03	4.77	-.20	5.23	+.26
Lot 2............	30°	4,000	Upper	4.49	-.48	4.59	-.38	4.73	-.24	4.61	-.36
Lot 10...........	30°	4,000	Middle	3.33	-1.64	4.96	-.01	4.94	-.03	4.90	-.07
Lot 7............	30°	4,000	Lower	([2])	([2])	4.67	-.30	5.03	+.06	4.83	-.14
Lot 4............	90°	2,000	Upper	4.59	-.38	4.90	-.07	4.99	+.02	5.12	+.15
Lot 12...........	90°	2,000	Middle	4.91	-.06	4.89	-.08	4.95	-.02	4.75	-.22
Lot 5............	90°	2,000	Lower	5.71	+.74	4.71	-.26	4.94	.03	4.66	-.31
Lot 3............	90°	4,000	Upper	4.86	-.11	4.88	-.09	4.93	-.04	4.90	-.07
Lot 11...........	90°	4,000	Middle	4.74	-.23	5.17	+.20	4.96	-.01	4.79	-.18
Lot 6............	90°	4,000	Lower	5.00	+.03	5.16	+.19	4.90	-.07	4.90	-.07
Average........	--	--	--	4.46	--	4.90	--	4.92	--	4.86	--
Wheat:[1]											
Lot 1............	30°	2,000	Upper	89.48	-.62	90.80	+.70	90.10	+.00	89.98	-.12
Lot 9............	30°	2,000	Middle	91.46	+1.36	89.84	-0.26	90.13	+.03	90.23	+.13
Lot 8............	30°	2,000	Lower	91.74	+1.64	90.58	+0.48	90.61	+.51	90.21	+.11
Lot 2............	30°	4,000	Upper	90.73	+.63	90.48	+.38	90.45	+.35	90.57	+.47
Lot 10...........	30°	4,000	Middle	91.26	+1.16	90.11	+.01	90.39	+.29	90.36	+.26
Lot 7............	30°	4,000	Lower	([2])	([2])	90.29	+.19	90.33	+.23	90.09	-.01
Lot 4............	90°	2,000	Upper	90.81	+.71	89.84	-.26	90.16	-.06	89.65	-.45
Lot 12...........	90°	2,000	Middle	89.57	-.53	89.48	-.62	90.26	+.16	90.28	+.18
Lot 5............	90°	2,000	Lower	88.92	-1.18	90.51	+.41	90.53	+.43	90.55	+.45
Lot 3............	90°	4,000	Upper	91.20	+1.10	89.85	-.25	90.26	+.16	90.27	+.17
Lot 11...........	90°	4,000	Middle	89.13	-.97	89.72	-.38	90.22	+.12	90.09	-.01
Lot 6............	90°	4,000	Lower	91.20	+1.10	90.38	+.28	90.45	+.35	90.60	+.50
Average........	--	--	--	90.50	--	90.15	--	90.32	--	90.24	--
Screenings:[1]											
Lot 1............	30°	2,000	Upper	7.49	+2.56	4.62	-.31	5.13	+.20	5.33	+.40
Lot 9............	30°	2,000	Middle	3.75	-1.18	4.85	-.08	4.70	-.23	4.77	-.16
Lot 8............	30°	2,000	Lower	4.69	-.24	4.48	-.45	4.62	-.31	4.56	-.37
Lot 2............	30°	4,000	Upper	4.78	-.15	4.93	+.00	4.82	-.11	4.82	-.11
Lot 10...........	30°	4,000	Middle	5.41	+.48	4.93	+.00	4.67	-.26	4.74	-.19
Lot 7............	30°	4,000	Lower	([2])	([2])	5.04	+.11	4.64	-.29	5.08	+.15
Lot 4............	90°	2,000	Upper	4.60	-.33	5.26	+.33	4.85	-.08	5.23	+.30
Lot 12...........	90°	2,000	Middle	5.52	+.59	5.63	+.70	4.79	-.14	4.97	+.00
Lot 5............	90°	2,000	Lower	5.37	+.44	4.78	-.15	4.53	-.40	4.79	-.14
Lot 3............	90°	4,000	Upper	3.94	-.99	5.27	+.34	4.81	-.12	4.83	-.10
Lot 11...........	90°	4,000	Middle	6.13	+1.20	5.11	+.18	4.82	-.11	5.12	+.19
Lot 6............	90°	4,000	Lower	3.80	-1.13	4.54	-.39	4.65	-.28	4.50	-.43
Average........	--	--	--	5.04	--	4.95	--	4.75	--	4.90	--
STRAND											
Corn:[1]											
Lot 9............	30°	2,000	Upper	4.43	-.54	4.86	-.11	5.04	+.07	4.84	-.13
Lot 8............	30°	2,000	Middle	4.94	-.03	4.82	-.15	4.86	-.11	4.91	-.06
Lot 1[3]...........	30°	2,000	Lower	--	--	--	--	--	--	--	--
Lot 10...........	30°	4,000	Upper	4.57	-.40	4.76	-.21	4.96	-.01	4.86	-.11
Lot 7............	30°	4,000	Midlle	([2])	([2])	4.90	-.07	4.77	-.20	4.99	+.02
Lot 2............	30°	4,000	Lower	4.05	-.92	4.89	-.08	4.71	-.26	4.92	-.05
Lot 12...........	90°	2,000	Upper	3.81	-1.16	4.92	-.05	5.02	+.05	5.32	+.35
Lot 5............	90°	2,000	Middle	4.10	-.87	4.95	-.02	4.78	-.19	4.71	-.26
Lot 4............	90°	2,000	Lower	4.99	+.02	4.83	-.14	4.65	-.32	4.84	-.13
Lot 11...........	90°	4,000	Upper	3.65	-1.32	4.89	-.08	4.80	-.17	4.95	-.02
Lot 6............	90°	4,000	Middle	5.15	+.18	4.79	-.18	4.89	-.08	4.96	-.01
Lot 3............	90°	4,000	Lower	4.02	-.95	5.07	+.10	4.90	-.07	4.90	-.07
Average........	--	--	--	4.37	--	4.88	--	4.85	--	4.93	--

See footnotes at end of table.

TABLE 6.--Percentage of corn, wheat, and screenings found in lots 1 to 12 of wheat by four samplers and deviation from component in original lot, by sampler and cycle--Continued

Sampler, component, and lot no.	Angle of spout	Grain flow rate	Sampling device position	Cycle 1		Cycle 2		Cycle 3		Cycle 4	
				Component in sample	Deviation from lot percentage	Component in sample	Deviation from lot percentage	Component in sample	Deviation from lot percentage	Component in sample	Deviation from lot percentage
STRAND--Con.		Lb./min.		Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Wheat:[1]											
Lot 9	30°	2,000	Upper	92.25	+2.15	90.18	+.08	90.17	+.07	89.87	-.23
Lot 8	30°	2,000	Middle	90.55	+.45	90.04	-.06	90.32	+.22	89.99	-.11
Lot 1[3]	30°	2,000	Lower	--	--	--	--	--	--	--	--
Lot 10	30°	4,000	Upper	90.39	+.29	90.87	+.77	89.87	-.23	89.95	-.15
Lot 7	30°	4,000	Middle	(2)	(2)	90.26	+.16	90.27	+.17	89.94	-.16
Lot 2	30°	4,000	Lower	91.98	+1.88	90.49	+.39	90.50	+.40	90.32	+.22
Lot 12	90°	2,000	Upper	92.05	+1.95	90.58	+.48	90.17	+.07	90.00	-.10
Lot 5	90°	2,000	Middle	91.81	+1.71	90.18	+.08	90.71	+.61	90.80	+.70
Lot 4	90°	2,000	Lower	90.69	+.59	90.38	+.28	90.84	+.74	90.47	+.37
Lot 11	90°	4,000	Upper	91.67	+1.57	90.59	+.49	89.89	-.21	90.42	+.32
Lot 6	90°	4,000	Middle	89.28	-.82	89.78	-.32	90.41	+.31	90.31	+.21
Lot 3	90°	4,000	Lower	89.99	-.11	90.14	+.04	90.41	+.31	90.60	+.50
Average	--	--	--	91.07	--	90.32	--	90.32	--	90.24	--
Screenings:[1]											
Lot 9	30°	2,000	Upper	3.32	-1.61	4.96	+.03	4.79	-.14	5.29	+.36
Lot 8	30°	2,000	Middle	4.51	-.42	5.14	+.21	4.82	-.11	5.10	+.17
Lot 1[3]	30°	2,000	Lower	--	--	--	--	--	--	--	--
Lot 10	30°	4,000	Upper	5.04	+.11	4.37	-.56	5.17	+.24	5.19	+.26
Lot 7	30°	4,000	Middle	(2)	(2)	4.84	-.09	4.96	+.03	5.07	+.14
Lot 2	30°	4,000	Lower	3.97	-.96	4.62	-.31	4.79	-.14	4.76	-.17
Lot 12	90°	2,000	Upper	4.14	-.79	4.50	-.43	4.81	-.12	4.68	-.25
Lot 5	90°	2,000	Middle	4.09	-.84	4.87	-.06	4.51	-.42	4.49	-.44
Lot 4	90°	2,000	Lower	4.32	-.61	4.79	-.14	4.51	-.42	4.69	-.24
Lot 11	90°	4,000	Upper	4.68	-.25	4.52	-.41	5.31	+.38	4.63	-.30
Lot 6	90°	4,000	Middle	5.57	+.64	5.43	+.50	4.70	-.23	4.73	-.20
Lot 3	90°	4,000	Lower	5.99	+1.06	4.79	-.14	4.69	-.24	4.50	-.43
Average	--	---	--	4.56	--	4.80	--	4.82	--	4.83	--
GUSTAFSON											
Corn:[1]											
Lot 8	30°	2,000	Upper	3.93	-1.04	4.82	-.15	4.87	-.10	4.80	-.17
Lot 1	30°	2,000	Middle	5.11	+.14	4.84	-.13	4.84	-.13	4.92	-.05
Lot 9	30°	2,000	Lower	4.94	-.03	4.86	-.11	5.08	+.11	5.09	+.12
Lot 7	30°	4,000	Upper	(2)	(2)	4.30	-.67	4.96	-.01	4.85	-.12
Lot 2	30°	4,000	Middle	4.59	-.38	4.94	-.03	5.00	+.03	5.06	+.09
Lot 10	30°	4,000	Lower	4.25	-.72	5.09	+.12	4.81	-.16	4.95	-.02
Lot 5	90°	2,000	Upper	3.41	-1.56	5.25	+.28	5.30	+.33	5.05	+.08
Lot 4	90°	2,000	Middle	4.57	-.40	4.77	-.20	5.08	+.11	4.95	-.02
Lot 12	90°	2,000	Lower	4.22	-.75	5.06	+.09	5.23	+.26	5.26	+.29
Lot 6	90°	4,000	Upper	3.71	-1.26	4.98	+.01	5.43	+.46	4.97	+.00
Lot 3	90°	4,000	Middle	4.89	-.08	4.98	+.01	5.09	+.12	4.98	+.01
Lot 11	90°	4,000	Lower	5.34	+.37	4.81	-.16	4.94	-.03	4.98	+.01
Average	--	--	--	4.45	--	4.89	--	5.05	--	4.99	--
Wheat:[1]											
Lot 8	30°	2,000	Upper	91.59	+1.49	90.94	+.84	90.15	+.05	90.55	+.45
Lot 1	30°	2,000	Middle	89.05	-1.05	89.97	-.13	90.01	-.09	89.92	-.18
Lot 9	30°	2,000	Lower	90.40	+.30	90.17	+.07	89.92	-.18	89.91	-.19
Lot 7	30°	4,000	Upper	(2)	(2)	90.55	+.45	90.15	+.05	90.02	-.08
Lot 2	30°	4,000	Middle	91.73	+1.63	90.03	-.07	89.46	-.64	90.18	+.08
Lot 10	30°	4,000	Lower	91.17	+1.07	89.77	-.33	90.32	+.22	90.28	+.18
Lot 5	90°	2,000	Upper	92.83	+2.73	89.77	-.33	90.21	+.11	90.14	+.04
Lot 4	90°	2,000	Middle	90.15	+.05	89.91	-.19	89.94	-.16	90.40	+.30
Lot 12	90°	2,000	Lower	90.72	+.62	90.11	+.01	89.71	-.39	89.72	-.38
Lot 6	90°	4,000	Upper	92.32	+2.22	89.54	-.56	89.91	-.19	90.28	+.18
Lot 3	90°	4,000	Middle	90.41	+.31	89.92	-.18	90.48	+.38	90.42	+.32
Lot 11	90°	4,000	Lower	89.69	-.41	90.22	+.12	90.06	-.04	90.08	-.02
Average	--	--	--	90.91	--	90.08	--	90.03	--	90.16	--

See footnotes at end of table.

TABLE 6.--Percentage of corn, wheat, and screenings found in lots 1 to 12 of wheat by four samplers and deviation from component in original lot, by sampler and cycle--Continued

Sampler, component, and lot no.	Angle of spout	Grain flow rate	Sampling device position	Cycle 1		Cycle 2		Cycle 4		Cycle 5	
				Component in sample	Deviation from lot percentage	Component in sample	Deviation from lot percentage	Component in sample	Deviation from lot percentage	Component in sample	Deviation from lot percentage
GUSTAFSON--con.		Lb./min.		Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Screenings:[1]											
Lot 8...........	30°	2,000	Upper	4.48	-.45	4.24	-.69	4.98	+.05	4.65	-.28
Lot 1...........	30°	2,000	Middle	5.84	+.91	5.19	+.26	5.15	+.22	5.16	+.23
Lot 9...........	30°	2,000	Lower	4.66	-.27	4.97	+.04	5.00	+.07	5.00	+.07
Lot 7...........	30°	4,000	Upper	(2)	(2)	5.15	+.22	4.89	-.04	5.13	+.20
Lot 2...........	30°	4,000	Middle	3.68	-1.25	5.03	+.10	5.54	+.61	4.76	-.17
Lot 10..........	30°	4,000	Lower	4.58	-.35	5.14	+.21	4.87	-.06	4.77	-.16
Lot 5...........	90°	2,000	Upper	3.76	-1.17	4.98	+.05	4.49	-.44	4.81	-.12
Lot 4...........	90°	2,000	Middle	5.28	+.35	5.32	+.39	4.98	+.05	4.65	-.28
Lot 12..........	90°	2,000	Lower	5.06	+.13	4.83	-.10	5.06	+.13	5.02	+.09
Lot 6...........	90°	4,000	Upper	3.97	-.96	5.48	+.55	4.66	-.27	4.75	-.18
Lot 3...........	90°	4,000	Middle	4.70	-.23	5.10	+.17	4.43	-.50	4.60	-.33
Lot 11..........	90°	4,000	Lower	4.97	+.04	4.97	+.04	5.00	+.07	4.94	+.01
Average........	--	--	--	4.63	--	5.03	--	4.92	--	4.85	--
PELICAN											
Corn:[1]											
Lot 1...........	30°	2,000	Bottom	6.44	+1.47	5.49	+.52	4.93	-.04	5.13	+.16
Lot 8...........	30°	2,000	Bottom	6.19	+1.22	5.27	+.30	4.89	-.08	4.71	-.26
Lot 9...........	30°	2,000	Bottom	4.66	-.31	5.29	+.32	5.11	+.14	5.11	+.14
Lot 2...........	30°	4,000	Bottom	4.51	-.46	5.12	+.15	4.91	-.06	4.62	-.35
Lot 7...........	30°	4,000	Bottom	(2)	(2)	5.08	+.11	5.34	+.37	5.31	+.34
Lot 10..........	30°	4,000	Bottom	5.71	+.74	5.27	+.30	5.07	+.10	5.31	+.34
Lot 4...........	90°	2,000	Bottom	5.64	+.67	5.18	+.21	4.85	-.12	5.03	+.06
Lot 5...........	90°	2,000	Bottom	5.10	+.13	4.99	+.02	5.24	+.27	4.88	-.09
Lot 12..........	90°	2,000	Bottom	4.90	-.07	5.35	+.38	5.17	+.20	4.76	-.21
Lot 3...........	90°	4,000	Bottom	5.37	+.40	5.17	+.20	5.32	+.35	5.16	+.19
Lot 6...........	90°	4,000	Bottom	4.92	-.05	5.14	+.17	5.18	+.21	4.90	-.07
Lot 11..........	90°	4,000	Bottom	5.60	+.63	4.84	-.13	4.89	-.08	5.14	+.17
Average........	--	--	--	5.37	--	5.18	--	5.08	--	5.00	--
Wheat:[1]											
Lot 1...........	30°	2,000	Bottom	87.95	-2.15	89.17	-.93	90.84	+.74	90.83	+.73
Lot 8...........	30°	2,000	Bottom	87.34	-2.76	90.26	+.16	90.54	+.44	90.58	+.48
Lot 9...........	30°	2,000	Bottom	89.57	-.53	90.15	+.05	90.51	+.41	90.40	+.30
Lot 2...........	30°	4,000	Bottom	89.87	-.23	90.46	+.36	90.23	+.13	90.40	+.30
Lot 7...........	30°	4,000	Bottom	(2)	(2)	90.16	+.06	90.28	+.18	90.15	+.05
Lot 10..........	30°	4,000	Bottom	90.12	+.02	89.87	-.23	90.35	+.25	90.03	-.07
Lot 4...........	90°	2,000	Bottom	89.67	-.43	90.63	+.53	90.41	+.31	90.81	+.71
Lot 5...........	90°	2,000	Bottom	89.54	-.56	90.75	+.65	90.04	-.06	90.69	+.59
Lot 12..........	90°	2,000	Bottom	89.87	-.23	89.59	-.51	90.40	+.30	90.92	+.82
Lot 3...........	90°	4,000	Bottom	89.31	-.79	90.46	+.36	90.07	-.03	90.78	+.68
Lot 6...........	90°	4,000	Bottom	91.70	+1.60	90.84	+.74	90.23	+.13	90.11	+.01
Lot 11..........	90°	4,000	Bottom	90.10	.00	90.57	+.47	90.39	+.29	90.33	+.23
Average	--	--	--	89.55	--	90.24	--	90.36	--	90.50	--
Screenings:[1]											
Lot 1...........	30°	2,000	Bottom	5.61	+.68	5.34	+.41	4.23	-.70	4.04	-.89
Lot 8...........	30°	2,000	Bottom	6.47	+1.54	4.47	-.46	4.57	-.36	4.71	-.22
Lot 9...........	30°	2,000	Bottom	5.77	+.84	4.56	-.37	4.38	-.55	4.49	-.44
Lot 2...........	30°	4,000	Bottom	5.62	+.69	4.42	-.51	4.86	-.07	4.98	+.05
Lot 7...........	30°	4,000	Bottom	(2)	(2)	4.76	-.17	4.38	-.55	4.54	-.39
Lot 10..........	30°	4,000	Bottom	4.17	-.76	4.86	-.07	4.58	-.35	4.66	-.27
Lot 4...........	90°	2,000	Bottom	4.69	-.24	4.19	-.74	4.74	-.19	4.16	-.77
Lot 5...........	90°	2,000	Bottom	5.36	+.43	4.26	-.67	4.72	-.21	4.43	-.50
Lot 12..........	90°	2,000	Bottom	5.23	+.30	5.06	+.13	4.43	-.50	4.32	-.61
Lot 3...........	90°	4,000	Bottom	5.32	+.39	4.37	-.56	4.61	-.32	4.06	-.87
Lot 6...........	90°	4,000	Bottom	3.38	-1.55	4.02	-.91	4.59	-.34	4.99	+.06
Lot 11..........	90°	4,000	Bottom	4.30	-.63	4.59	-.34	4.72	-.21	4.53	-.40
Average........	--	--	--	5.08	--	4.58	--	4.57	--	4.49	--

[1] Percentage of component in original lot: Corn, 4.97%; wheat, 90.10%; screenings, 4.93%.

[2] All samples for cycle 1 of lot 7 were lost because of mechanical failure of one mechanical sampler.

[3] Sample data for lot 1 were not included because of an obvious restriction in grain flow caused by paint on interior of new sampler.

TABLE 7.--Average percentage of corn, wheat, and screenings found in 12 lots by four samplers, by spout angle, grain flow rate, and sampler position

[One increment sample per 2,000 lb. of grain]

Sampler and component[1]	Average by spout angle and grain flow rate				Average by sampler position		
	30°, angle		90° angle		Upper	Middle	Lower
	2,000 lb./min.	4,000 lb./min	2,000 lb./min	4,000 lb./min			
GAMET	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Corn	4.65	4.64	4.93	4.93	4.67	4.85	4.87
Wheat	90.43	90.46	90.05	90.27	90.29	90.16	90.46
Screenings	4.92	4.90	5.03	4.79	5.04	4.99	4.67
STRAND							
Corn	4.84	4.76	4.74	4.75	4.73	4.83	4.73
Wheat	90.42	90.44	90.72	90.29	90.56	90.31	90.57
Screenings	4.74	4.80	4.53	4.96	4.71	4.86	4.70
GUSTAFSON							
Corn	4.84	4.80	4.85	4.92	4.71	4.91	4.93
Wheat	90.22	90.33	90.30	90.28	90.60	90.12	90.14
Screenings-	4.94	4.87	4.85	4.80	4.69	4.96	4.93
PELICAN							
Corn	5.27	5.11	5.09	5.14	....	....	5.15
Wheat	89.34	90.17	90.28	90.41	....	....	90.18
Screenings	4.89	4.71	4.63	4.46	....	....	4.67

[1] Percentage of component in original lot: Corn, 4.97 percent; wheat, 90.10 percent; screenings 4.93 percent.
[2] Pelican was always at bottom.

TABLE 8.--Average percentage and standard deviation of corn, wheat, and screenings found in samples of wheat drawn by four samplers and the pooled standard deviation of three mechanical samplers, by cycle and sampling frequency.

Component, sampling frequency and sampler	Cycle 1		Cycle 2		Cycle 3		Cycle 4	
	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s
CORN[1]	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
2,000 lb:[2]								
Gamet	4.46	.81	4.90	.23	4.92	.12	4.86	.19
Strand	4.37	.53	4.88	.08	4.85	.12	4.93	.15
Gustafson	4.45	.61	4.89	.23	5.05	.19	4.99	.12
Average[3]	4.43	(.66)	4.89	(.19)	4.94	(.15)	4.93	(.16)
Pelican	5.37	.62	5.18	.17	5.08	.18	5.00	.23
4,000 lb:[2]								
Gamet	4.69	1.77	4.76	.36	4.89	.22	4.87	.17
Strand	4.93	1.30	4.79	.24	4.71	.22	5.02	.25
Gustafson	4.27	1.44	4.77	.36	5.04	.23	5.12	.23
Average[3]	4.63	(1.52)	4.77	(.33)	4.88	(.23)	5.00	(.22)
Pelican	5.28	1.87	5.02	.29	4.95	.24	5.01	.39
6,000 lb.:[2]								
Gamet	4.27	1.06	4.77	.44	4.87	.28	4.84	.27
Strand	4.72	1.37	4.92	.29	4.84	.26	4.79	.20
Gustafson	4.42	1.03	4.71	.50	4.99	.44	4.80	.26
Average[3]	4.47	(1.16)	5.80	(.42)	4.90	(.34)	4.81	(.24)
Pelican	5.74	2.35	5.42	.48	4.99	.26	4.82	.33
8,000 lb.:[2]								
Gamet	4.61	2.82	4.49	.48	4.72	.22	4.86	.33
Strand	4.91	2.94	4.46	.63	4.62	.26	4.94	.45
Gustafson	4.68	2.88	4.56	.59	4.98	.34	5.05	.35
Average[3]	4.73	(2.88)	4.50	(.57)	4.77	(.28)	4.95	(.38)
Pelican	5.60	3.51	5.17	.28	5.03	.40	5.12	.43
WHEAT[1]								
2,000 lb.:[2]								
Gamet	90.50	1.02	90.15	.41	90.32	.16	90.24	.27
Strand	91.07	1.02	90.32	.30	90.32	.30	90.24	.31
Gustafson	90.91	1.29	90.08	.37	90.03	.27	90.16	.24
Average[3]	90.83	(1.12)	90.18	(.36)	90.22	(.25)	90.21	(.27)
Pelican	89.55	1.14	90.24	.50	90.36	.22	90.50	.31
4,000 lb.:[2]								
Gamet	90.76	2.48	89.86	.81	90.26	.38	90.00	.34
Strand	90.77	1.71	90.00	.69	90.24	.59	89.84	.56
Gustafson	91.35	1.93	89.83	.73	89.95	.42	89.81	.33
Average[3]	90.96	(2.07)	89.90	(.75)	90.15	(.47)	89.88	(.43)
Pelican	90.29	2.49	90.09	.80	90.62	.51	90.64	.45
6,000 lb.:[2]								
Gamet	92.75	1.80	89.57	1.04	90.28	.45	89.80	.64
Strand	92.05	2.63	90.15	.83	90.12	.92	90.12	.65
Gustafson	92.06	1.99	89.89	1.16	90.02	.38	90.07	.40
Average[3]	92.29	(2.17)	89.87	(1.02)	90.14	(.63)	90.00	(.57)
Pelican	90.56	3.17	89.72	.80	90.42	.48	90.82	.45

See footnotes at end of table.

TABLE 8.--Average percentage and standard deviation of corn, wheat, and screenings found in samples of wheat drawn by four samplers and the pooled standard deviation of three mechanical samplers, by cycle and sampling frequency--Continued

Component, sampling frequency and sampler	Cycle 1		Cycle 2		Cycle 3		Cycle 4	
	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s
WHEAT-Con.	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
8,000 lb.:[2]								
Gamet	91.17	2.83	89.27	1.33	90.02	.66	89.64	.65
Strand	90.79	3.55	89.79	1.54	89.86	1.21	89.45	.89
Gustafson	91.17	2.66	89.42	1.62	89.90	.66	89.41	.66
Average[3]	91.04	(3.04)	89.49	(1.50)	89.93	(.88)	89.50	(.74)
Pelican	90.00	4.06	89.69	.70	90.56	.60	90.52	.50
SCREENINGS[1]								
2,000 lb.:[2]								
Gamet	5.04	1.12	4.95	.33	4.75	.16	4.90	.26
Strand	4.56	.79	4.80	.31	4.82	.25	4.83	.28
Gustafson	4.63	.66	5.03	.30	4.92	.30	4.85	.19
Average[3]	4.74	(.88)	4.93	(.31)	4.83	(.24)	4.86	(.25)
Pelican	5.08	.87	4.58	.38	4.57	.18	4.49	.32
4,000 lb.:[2]								
Gamet	4.54	1.67	5.38	.70	4.84	.36	5.14	.43
Strand	4.30	1.37	5.21	.65	5.05	.59	5.14	.61
Gustafson	4.39	1.52	4.39	.59	5.00	.40	5.07	.39
Average[3]	4.41	(1.53)	4.99	(.65)	4.96	(.46)	5.12	(.48)
Pelican	4.43	1.69	4.70	.75	4.43	.44	4.35	.40
6,000 lb.:[2]								
Gamet	2.98	1.73	5.66	1.00	4.85	.40	5.36	.71
Strand	3.23	2.40	4.92	.73	5.04	.81	5.09	.64
Gustafson	3.52	1.78	5.04	1.02	4.99	.46	5.14	.54
Average[3]	3.24	(1.97)	5.21	(.93)	4.96	(.58)	5.20	(.63)
Pelican	3.69	2.34	4.87	.70	4.58	.40	4.36	.40
8,000 lb.:[2]								
Gamet	4.22	2.07	6.24	1.20	5.26	.70	5.49	.85
Strand	4.30	2.39	5.74	1.23	5.52	1.43	5.61	1.06
Gustafson	4.15	2.52	6.02	1.22	5.12	.77	5.53	.69
Average[3]	4.22	(2.34)	6.00	(1.22)	5.30	(1.02)	5.54	(.88)
Pelican	4.40	2.59	5.13	.68	4.41	.50	4.35	.39

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[1] Percentage of component in original lot: Corn, 4.97; wheat 90.10; screenings, 4.93.

[2] Pounds of grain represented by each increment sample.

[3] Figures in parentheses are pooled standard deviations and were calculated by squaring the standard deviation for each mechanical sampler, dividing the sum of the three figures by 3, and taking the square root of the dividend; for example, the pooled standard deviation for corn, 2,000 lb./min., cycle 1, was calculated as follows:

$$\sqrt{\frac{(.81)^2 + (.53)^2 + (.61)^2}{3}} = 0.66$$

TABLE 9.--Average percentage and standard deviation of corn, wheat, and screenings found in samples of wheat drawn by three mechanical samplers and the pelican sampler, by cycle and sampling frequency

Cycle and sampling frequency[1]	Corn[2]				Wheat[2]				Screenings[2]			
	Mechanical samplers		Pelican		Mechanical samplers		Pelican		Mechanical samplers		Pelican	
	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Cycle 1:												
2,000 lb.	4.43	0.66	5.37	0.62	90.83	1.12	89.55	1.14	4.74	0.88	5.08	0.87
4,000 lb.	4.63	1.52	5.28	1.87	90.96	2.07	90.29	2.49	4.41	1.53	4.43	1.69
6,000 lb.	4.47	1.16	5.74	2.35	90.29	2.17	90.56	3.17	3.24	1.97	3.69	2.34
8,000 lb.	4.73	2.88	5.60	3.51	91.04	3.04	90.00	4.06	4.22	2.34	4.40	2.59
Cycle 2:												
2,000 lb.	4.89	.19	5.18	.17	90.18	.36	90.24	.50	4.93	.31	4.58	.38
4,000 lb.	4.77	.33	5.20	.29	89.90	.75	90.09	.80	4.99	.65	4.70	.75
6,000 lb.	5.80	.42	5.42	.48	89.87	1.02	89.72	.80	5.21	.93	4.87	.70
8,000 lb.	4.50	.57	5.17	.28	89.49	1.50	89.69	.70	6.00	1.22	5.13	.68
Cycle 3:												
2,000 lb.	4.94	.15	5.08	.18	90.22	.25	90.36	.22	4.83	.24	4.57	.18
4,000 lb.	4.88	.23	4.95	.24	90.15	.47	90.62	.51	4.96	.46	4.43	.44
6,000 lb.	4.90	.34	4.99	.26	90.14	.63	90.42	.48	4.96	.58	4.58	.40
8,000 lb.	4.77	.28	5.03	.40	89.93	.88	90.56	.60	5.30	1.02	4.41	.50
Cycle 4:												
2,000 lb.	4.93	.16	5.00	.23	90.21	.27	90.50	.31	4.86	.25	4.49	.32
4,000 lb.	5.00	.22	5.01	.39	89.88	.43	90.64	.45	5.12	.48	4.35	.40
6,000 lb.	4.81	.24	4.82	.33	90.00	.57	90.82	.45	5.20	.63	4.36	.40
8,000 lb.	4.95	.38	5.12	.43	89.50	.74	90.52	.50	5.54	.88	4.35	.39

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[1] Pounds of grain from which each increment sample was taken.

[2] Percentage of component in original lot: Corn, 4.97; wheat, 90.10; screenings, 4.93.

TABLE 10.--Average weight, standard deviation, and index of homogeneity of increment samples of wheat drawn by four samplers by spout angle, sampler position, grain flow rate, lot, and cycle

Sampler, spout angle, grain flow rate, lot, and sampler position	Average weight				Standard deviation				Index of homogeneity			
	Cycle 1	Cycle 2	Cycle 3	Cycle 4	Cycle 1	Cycle 2	Cycle 3	Cycle 4	Cycle 1	Cycle 2	Cycle 3	Cycle 4
GAMET	Grams	Grams	Grams	Grams								
30°, 2,000 lb./min.:												
1, upper	764	771	707	708	46	37	38	32	6	5	5	5
9, middle	526	551	549	550	20	20	21	22	4	4	4	4
8, lower	508	478	498	511	69	58	36	42	14	12	7	8
30°, 4,000 lb./min.:												
2, upper	1078	1091	1135	1051	58	50	67	53	5	5	6	5
10, middle	970	989	970	1006	33	34	41	36	3	3	4	4
7, lower	--	772	768	786	--	40	44	41	--	5	6	5
90°, 2,000 lb./min.:												
4, upper	552	553	579	564	45	45	51	53	8	8	9	9
12, middle	431	480	500	497	15	13	12	11	4	3	2	2
5, lower	585	657	647	600	40	66	51	30	7	10	8	5
90°, 4,000 lb./min.:												
3, upper	880	886	784	841	68	79	106	83	8	9	14	10
11, middle	733	729	739	745	27	14	24	14	4	2	3	2
6, lower	1218	1258	1431	1162	58	63	29	60	5	5	2	5
Average	750	768	776	752	--	--	--	--	--	--	--	--
STRAND												
30°, 2,000 lb./min.:												
9, upper	493	518	419	425	85	91	59	57	17	18	14	13
8, middle	705	574	592	596	70	28	33	68	10	5	6	11
1, lower	--	--	--	--	--	--	--	--	--	--	--	--
30°, 4,000 lb./min.:												
10, upper	844	839	824	848	55	34	63	54	7	4	8	6
7, middle	--	1120	1015	1213	--	48	29	136	--	4	3	11
2, lower	789	747	731	691	161	50	50	22	20	7	7	3
90°, 2,000 lb./min.:												
12, upper	314	352	384	371	96	101	106	100	30	29	28	27
5, middle	549	561	545	541	59	45	50	47	11	8	9	9
4, lower	613	627	683	704	94	132	119	81	15	21	17	11
90°, 4,000 lb./min.:												
11, upper	594	578	592	618	74	88	97	109	12	15	16	18
6, middle	858	894	874	907	88	92	93	84	10	10	11	9
3, lower	1105	1101	975	1134	95	166	172	173	9	15	18	15
Average	686	719	694	732	--	--	--	--	--	--	--	--
GUSTAFSON												
30°, 2,000 lb./min.:												
8, upper	775	687	768	868	94	52	53	196	12	8	7	23
1, middle	863	791	806	826	142	81	81	106	16	10	10	13
9, lower	597	636	615	615	45	44	35	37	8	7	6	6
30°, 4,000 lb./min.:												
7, upper	--	1536	1025	1126	--	475	105	168	--	31	10	15
2, middle	1148	1302	1143	1028	104	106	75	72	9	8	7	7
10, lower	1014	958	956	977	80	76	33	51	8	8	3	5
90°, 2,000 lb./min.:												
5, upper	526	514	508	516	76	35	59	68	14	7	12	13
4, middle	918	733	766	710	59	124	61	78	6	17	8	11
12, lower	581	629	652	636	87	87	88	83	15	14	14	13
90°, 4,000 lb./min.:												
6, upper	809	848	1035	794	108	78	507	92	13	9	49	12
3, middle	1325	1265	1063	1139	95	73	111	74	7	6	10	7
11, lower	967	963	983	1001	74	71	72	74	8	7	7	7
Average	866	905	860	853	--	--	--	--	--	--	--	--
PELICAN												
30°, 2,000 lb./min.:												
1, bottom	1073	1068	1005	862	168	208	213	161	16	19	21	19
8, ..do	878	794	467	500	135	95	104	96	15	12	22	19
9, ..do	598	516	524	499	71	76	95	42	12	15	18	8
30°, 4,000 lb./min.:												
2, bottom	803	795	868	806	170	153	145	123	21	19	17	15
7, ..do	--	1157	1163	1250	--	121	171	132	--	10	15	11
10, ..do	888	588	912	538	93	70	107	68	10	12	12	13
90°, 2,000 lb./min.:												
4, bottom	668	578	974	1010	59	43	83	98	9	7	9	10
5, ..do	652	692	684	676	57	77	58	56	9	11	8	8
12, ..do	537	619	621	608	68	47	78	55	13	8	13	9
90°, 4,000 lb./min.:												
3, bottom	1207	1097	1080	1077	169	69	157	154	14	6	15	15
6, ..do	1020	1064	1067	1029	142	116	101	117	14	11	10	11
11, ..do	819	833	826	821	81	81	79	73	10	10	10	9
Average	831	817	849	806	--	--	--	--	--	--	--	--

TABLE 11.--Average weight of increment samples of wheat drawn from lots 1 to 12 by four samplers, by spout angle, grain flow rate, and sampler position

Sampler	30° angle		90° angle		Sampler position		
	2,000 lb/min.	4,000 lb/min.	2,000 lb/min.	4,000 lb/min.	Upper	Middle	Lower or bottom[1]
	Grams	Grams	Grams	Grams	Grams	Grams	Grams
Gamet...........	593	965	554	995	809	685	792
Strand..........	540	878	520	852	563	770	825
Gustafson.......	737	1,110	641	1,016	822	989	799
Pelican.........	732	888	693	995			826

[1] Pelican was always at bottom.

TABLE 12.--Standard deviation of weights of composite samples of wheat drawn by four samplers from 12 lots, by cycle

Cycle	Gamet	Strand	Gustafson	Pelican
	Grams	Grams	Grams	Grams
1..............	259	223	246	210
2..............	249	245	314	228
3..............	280	212	202	229
4..............	225	271	206	249
Cycles pooled...	254	239	246	229

TABLE 13.--Grain flow rate and average weight of samples drawn by four samplers from 12 lots of wheat, by cycle

Lot, spout angle, and cycle	Flow rate	Average increment sample weight			
		Gamet	Strand	Gustafson	Pelican
	Lb./min.	Grams	Grams	Grams	Grams
Lot 1, 30°:					
Cycle 1	2,000	764	673	863	1,073
Cycle 2	2,094	771	838	791	1,068
Cycle 3	2,099	707	604	806	1,005
Cycle 4	2,086	708	675	826	862
Cycle 5	--	--	--	--	--
Cycle 6	2,098	650	736	764	983
Lot 8, 30°:					
Cycle 1	2,160	508	705	775	878
Cycle 2	1,966	478	574	687	794
Cycle 3	1,962	498	592	768	467
Cycle 4	1,971	511	596	868	500
Cycle 5	876	249	274	448	532
Lot 9, 30°					
Cycle 1	1,932	526	493	597	598
Cycle 2	1,900	551	518	636	516
Cycle 3	1,994	549	419	615	524
Cycle 4	1,995	550	425	615	499
Cycle 5	5,203	1,146	993	1,081	648
Lot 2, 30°					
Cycle 1	3,922	1,078	789	1,148	803
Cycle 2	3,947	1,091	747	1,302	795
Cycle 3	4,044	1,135	731	1,143	868
Cycle 4	3,893	1,051	691	1,028	806
Lot 7, 30°					
Cycle 1	--	--	--	--	--
Cycle 2	4,215	772	1,120	1,536	1,157
Cycle 3	4,108	768	1,015	1,025	1,163
Cycle 4	4,243	786	1,213	1,126	1,250
Lot 10, 30°					
Cycle 1	3,766	970	844	1,014	888
Cycle 2	3,863	989	839	958	588
Cycle 3	3,748	970	824	956	912
Cycle 4	3,898	1,006	848	977	538
Cycle 5	894	247	252	352	245
Lot 3, 90°					
Cycle 1	3,626	880	1,105	1,325	1,207
Cycle 2	3,804	886	1,101	1,265	1,097
Cycle 3	3,284	784	975	1,063	1,080
Cycle 4	3,744	841	1,134	1,139	1,077
Lot 6, 90°					
Cycle 1	3,597	1,218	858	809	1,020
Cycle 2	3,742	1,258	894	848	1,064
Cycle 3	3,683	1,431	874	1,035	1,067
Cycle 4	3,662	1,162	907	794	1,029
Cycle 5	5,370	1,460	1,114	1,098	779
Lot 11, 90°					
Cycle 1	3,434	733	594	967	819
Cycle 2	3,392	729	578	963	833
Cycle 3	3,446	739	592	983	826
Cycle 4	3,488	745	618	1,001	821
Cycle 5	806	214	169	414	277
Lot 4, 90°					
Cycle 1	1,977	552	613	918	668
Cycle 2	1,997	553	627	733	578
Cycle 3	2,004	579	683	766	974
Cycle 4	1,997	564	704	710	1,010
Lot 5, 90°					
Cycle 1	2,039	585	549	526	652
Cycle 2	2,029	657	561	514	692
Cycle 3	1,973	647	545	508	684
Cycle 4	1,950	600	541	516	676
Cycle 5	611	203	147	230	154
Lot 12, 90°					
Cycle 1	1,715	431	314	581	537
Cycle 2	1,971	480	352	629	619
Cycle 3	2,066	500	384	652	621
Cycle 4	2,044	497	371	636	608
Cycle 5	5,323	985	861	1,308	700

TABLE 14.--Average weight of lightweight sample of alternating samples of wheat, expressed as a percentage of the heavier sample, by sampler, lot, and cycle.

Sampler, spout angle, flow rate, lot, and sampler position	Cycle 1	Cycle 2	Cycle 3	Cycle 4
GAMET	Percent	Percent	Percent	Percent
30°, 2,000 lb./min:				
1, upper	96	95	94	95
9, middle	98	98	96	95
8, lower	93	99	92	98
30°, 4,000 lb./min:				
2, upper	99	92	90	92
10, middle	98	99	99	99
7, lower	--	96	100	100
90°, 2,000 lb./min:				
4, upper	85	87	85	84
12, middle	99	99	100	100
5, lower	94	84	91	98
90°, 4,000 lb./min:				
3, upper	87	85	83	83
11, middle	97	98	99	98
6, lower	96	99	97	98
Average	95	94	94	95
STRAND				
30°, 2,000 lb./min:				
9, upper	71	71	76	77
8, middle	85	94	92	81
1, lower	98	80	95	85
30°, 4,000 lb./min:				
10, upper	91	93	87	89
7, middle	--	96	96	83
2, lower	91	90	90	99
90°, 2,000 lb./min:				
12, upper	54	56	58	58
5, middle	82	86	86	85
4, lower	74	66	72	82
90°, 4,000 lb./min:				
11, upper	80	74	73	76
6, middle	82	83	82	84
3, lower	93	76	77	75
Average	82	80	82	81
GUSTAFSON				
30°, 2,000 lb./min:				
8, upper	92	98	100	81
1, middle	83	87	86	81
9, lower	91	90	92	95
30°, 4,000 lb./min:				
7, upper	--	54	94	86
2, middle	97	94	97	99
10, lower	92	99	98	92
90°, 2,000 lb./min:				
5, upper	96	97	93	96
4, middle	93	72	91	85
12, lower	76	77	78	78
90°, 4,000 lb./min:				
6, upper	96	98	64	87
3, middle	98	96	92	92
11, lower	91	88	88	87
Average	91	89	89	88

TABLE 15.--Average, standard deviation, and coefficient of variation of components of wheat samples drawn with the pelican sampler using two sampling techniques

Spout angle, grain flow rate, and item	Standard pelican				Check pelican			
	Corn	Wheat	Screenings	Weight of composite sample	Corn	Wheat	Screenings	Weight of composite sample
	Percent	Percent	Percent	Grams	Percent	Percent	Percent	Grams
30°, 2,000 lb./min.:								
Average[1]..........	5.27	89.84	4.89	14,033	4.94	89.84	5.23	14,586
Standard deviation	.55	1.14	.74	3,998	.66	.98	.72	1,799
Coefficient of variation.......	10.37	1.27	15.10	28.49	13.31	1.09	13.70	12.33
30°, 4,000 lb./min.:								
Average[1]..........	5.11	90.17	4.71	17,407	5.22	89.80	4.98	19,455
Standard deviation	.34	.20	.38	3,955	.42	.51	.41	2,614
Coefficient of variation.......	6.66	.22	8.17	22.72	8.03	.57	8.14	13.44
90°, 2,000 lb./min.:								
Average[1]..........	5.09	90.28	3.63	13,786	5.25	90.05	4.70	11,517
Standard deviation	.25	.51	.41	2,929	.26	.74	.56	2,904
Coefficient of variation.......	4.84	.56	8.08	21.25	5.03	.83	11.82	25.21
90°, 4,000 lb./min.:								
Average[1]..........	5.14	90.41	4.46	21,832	5.09	90.46	4.45	17,436
Standard deviation	.22	.57	.50	2,704	.47	.52	.22	3,315
Coefficient of variation.......	4.37	.63	11.16	12.38	9.17	.58	4.97	19.01
All samples:								
Average[1]..........	5.15	90.18	4.67	16,751	5.12	90.04	4.84	15,670
Standard deviation	.36	.70	.53	3,434	.48	.72	.51	2,718
Coefficient of variation.......	7.07	.78	11.34	20.50	9.29	.80	10.62	17.34

[1] Average for composite samples of lots.

TABLE 16.--Average percentage of corn, wheat, and screenings in total and cut-down samples[1]

Sample size range	CORN		WHEAT		SCREENINGS		Number of samples
	Total sample	Cut-down sample	Total sample	Cut-down sample	Total sample	Cut-down sample	
	Percent	Percent	Percent	Percent	Percent	Percent	
0 to 5,000 grams................	4.86	4.82	90.48	90.54	4.66	4.64	254
5,000 to 10,000 grams...........	4.92	4.92	90.28	90.32	4.80	4.76	232
10,000 to 15,000 grams..........	4.61	4.44	86.28	86.60	9.11	8.96	27
15,000 to 20,000 grams..........	4.86	4.89	88.03	88.02	7.11	7.09	30
20,000 to 25,000 grams..........	5.06	4.99	90.09	90.22	4.85	4.79	23
Over 25,000 grams...............	5.09	5.09	89.85	89.89	5.06	5.02	18
All samples..................	4.89	4.86	90.04	90.11	5.07	5.03	584

[1] The standard deviation for percentage differences between pairs were corn, 0.39 percent; wheat, 0.47 percent; and screenings, 0.18 percent.

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